

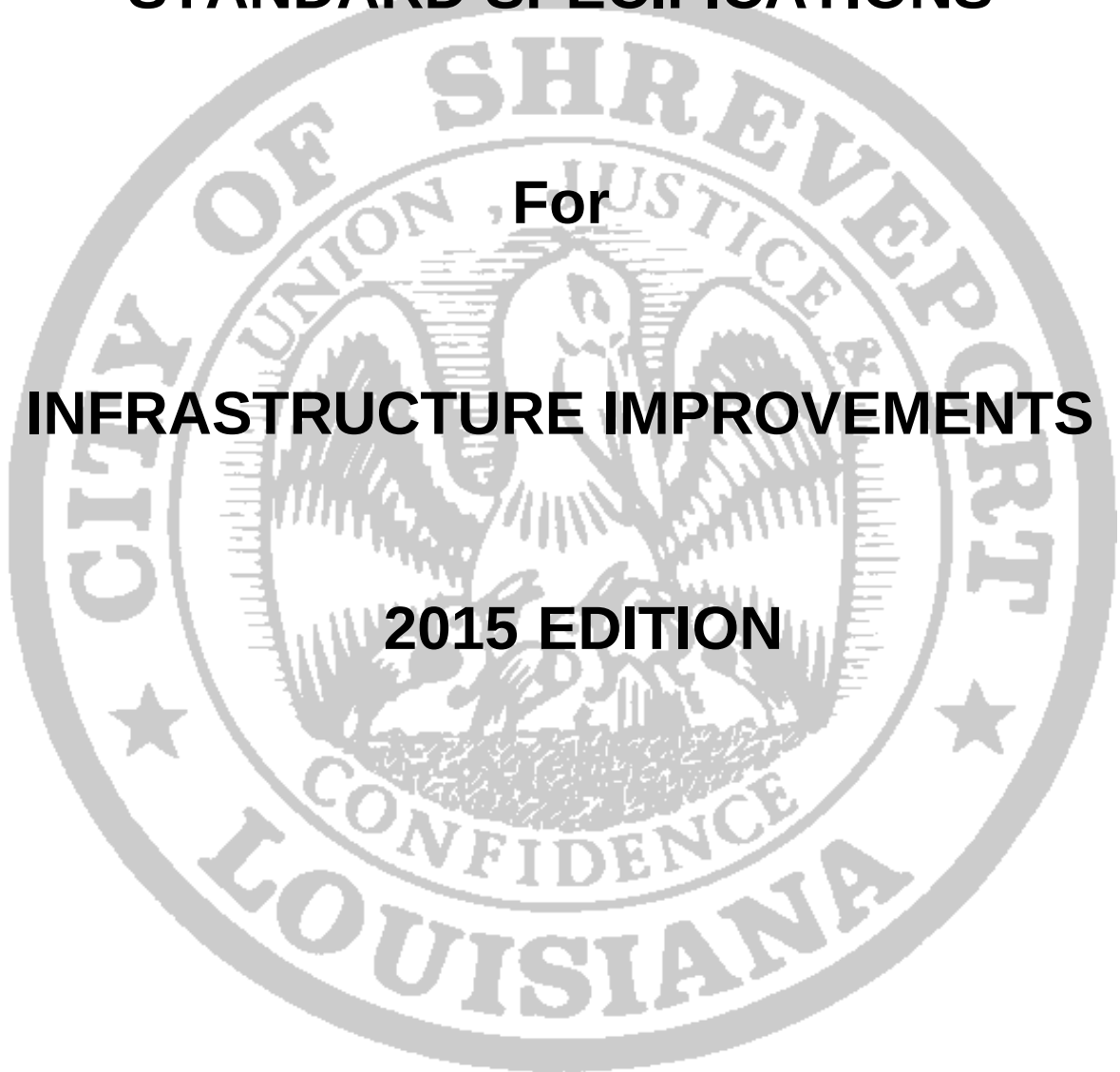
CITY OF SHREVEPORT, LOUISIANA

STANDARD SPECIFICATIONS

For

INFRASTRUCTURE IMPROVEMENTS

2015 EDITION



**DEPARTMENT OF ENGINEERING
AND ENVIRONMENTAL SERVICES
OFFICE OF THE CITY ENGINEER**

TABLE OF CONTENTS

PART 1 - GENERAL PROVISIONS

PAGE

Section 100	Definitions and Abbreviations	100
Section 101	Bidding Requirements	101
Section 102	Award and Execution of Contract.....	102
Section 103	Scope of Work	103
Section 104	Control of Work.....	104
Section 105	Changes in Work	105
Section 106	Control of Materials.....	106
Section 107	Governmental Regulations	107
Section 108	Contractor's Responsibilities.....	108
Section 109	Utilities.....	109
Section 110	Prosecution and Progress of Work	110
Section 111	Measurement and Payment.....	111

PART 2 - MATERIALS

Section 200	Aggregates	200
Section 201	Concrete, Mortar and Related Material	201
Section 202	Masonry Materials	202
Section 203	Soil and Grasses	203
Section 204	Bituminous Materials	204
Section 205	Timber and Preservative Treatment.....	205
Section 206	Piles	206
Section 207	Miscellaneous Metal Items.....	207
Section 208	Storm Drain Pipe	208
Section 209	Water and Sewer – Piping and Appurtenance.....	209
Section 210	Paint and Protective Coatings.....	210
Section 211	Geotextile Fabric and Geocomposite Systems	211
Section 212	Erosion Control Matting and Hardware	212
Section 213	Traffic Signal Materials	213
Section 214	This section left blank	
Section 215	Signs and Pavement Markings	215

PART 3 - EARTHWORK

Section 301	Clearing and Grubbing.....	301
Section 302	Removal of Structures and Obstructions.....	302
Section 303	Roadway Excavation	303
Section 304	Fill Construction.....	304
Section 305	Borrow Excavation.....	305
Section 306	Muck Excavation	306
Section 307	Channel Excavation.....	307
Section 308	Structural Excavation and Backfill.....	308
Section 309	Rip-rap Construction.....	309
Section 310	Temporary Erosion Control.....	310

PART 4 - ROADWAY SUBGRADE PREPARATION AND BASE COAT

Section 401	Subgrade Preparation.....	401
Section 402	Soil Cement Base.....	402
Section 403	Aggregate Base.....	403
Section 404	Base Reinforcement	404
Section 405	Pavement Undersealing	405

PART 5 - AGGREGATE SURFACE COURSE

Section 501	Aggregate Surface Course	501
Section 502	Tack Coat.....	502
Section 503	Prime Coat	503
Section 504	Asphaltic Surface Treatment.....	504
Section 505	Asphaltic Concrete Friction Course.....	505
Section 506	Slurry Seal Coat Surfacing.....	506
Section 507	Asphaltic Concrete Pavement.....	507
Section 508	Cold Planing Asphaltic Pavement.....	508
Section 509	Portland Cement Concrete Pavement.....	509

PART 6 - CONCRETE CONSTRUCTION

Section 601	Concrete Structures.....	601
Section 602	Pneumatic Placed Concrete	602
Section 603	Precast Concrete.....	603
Section 604	Prestressed Concrete	604
Section 605	Concrete Curbs, Walks, Gutters, Driveways	605
Section 606	Concrete Reinforcement.....	606
Section 607	Drilled Shaft Foundations	607
Section 608	Ditch Paving and Concrete Revetment	608
Section 609	Raising, Void Filling and Undersealing Pavements Using Polyurethane	609

PART 7 - MASONRY CONSTRUCTION

Section 701	Concrete Masonry Unit Construction	701
Section 702	Brick Masonry.....	702
Section 703	Mechanically Stabilized Earth Wall With Masonry Unit.....	703

PART 8 - METAL FABRICATION AND CONSTRUCTION

Section 801	Structural Steel.....	801
Section 802	Metal Railings.....	802
Section 803	Chain Link Fence.....	803

PART 9 - PILE DRIVING AND TIMBER CONSTRUCTION

Section 901	Pile Driving	901
Section 902	Timber Construction	902

PART 10 - PIPELINE CONSTRUCTION

Section 1001	Storm Drain Pipe Installation	1001
Section 1002	Excavation and Backfill	1002
Section 1003	Abandonment of Existing Water Main and Sanitary Sewer Facilities	1003
Section 1004	Trench Safety Systems.....	1004
Section 1005	Trench Dewatering	1005
Section 1006	Boring, Tunneling and Pipe Jacking Operations	1006

PART 11 - PAINTING

Section 1101	Painting	1101

PART 12 - MISCELLANEOUS CONSTRUCTION

Section 1201	Landscaping and Seeding	1201
Section 1202	Mobilization	1202
Section 1203	Erosion Control Systems	1203

PART 13 - TRAFFIC

Section 1301	Traffic Signs and Devices	1301
Section 1302	Traffic Control Components	1302
Section 1303	Plastic Pavements Markings.....	1303
Section 1304	Painted Traffic Striping	1304
Section 1305	Raised Pavement Markers.....	1305
Section 1306	Temporary Signs, Barricades, Barriers & Pavement Markings.....	1306
Section 1307	Street Lighting	1307

PARTS 14 THRU 19 NOT USED

PARTS 20 – SEWER

Section 2000	Gravity Sewer Mains.....	2000
Section 2100	Sewer Force Mains.....	2100
Section 2200	Sanitary Sewer Manholes	2200
Section 2210	Manhole Rehabilitation	2210
Section 2220	Monolithic Manhole Lining Systems	2220
Section 2300	Sanitary Sewer Testing of Pipes and Manholes.....	2300
Section 2400	Manhole Inflow Preventers	2400
Section 2600	Cured in Place Within-A-Pipe	2600
Section 2700	Pipe Bursting	2700
Section 2800	Package Submersible Lift Station	2800
Section 2810	Wetwell Lining System.....	2810
Section 2900	Sewer Line Cleaning.....	2900

PARTS 30 – WATER

Section 3000	Water Mains	3000
Section 3100	Testing, Flushing and Sterilization of Water Mains	3100
Section 3200	Water Service Lines and Meter Boxes	3200
Section 3300	Fire Hydrants	3300
Section 3400	Waterworks Valves	3400
Section 3500	Wet Connections and Appurtenances.....	3500

PARTS 40 – GENERAL REQUIREMENTS

Section 4010	Summary of Work	4010
Section 4014	Construction Sequence	4014
Section 4025	Measurement and Payment.....	4025
Section 4026	Pay Estimates.....	4026
Section 4035	Change Order Procedures.....	4035
Section 4038	Requests for Information	4038
Section 4045	Cutting Coring and Patching	4045
Section 4050	Project Controls (Surveying)	4050
Section 4110	Storm Water Permitting Procedures	4110
Section 4200	Project Meetings.....	4200
Section 4300	Submittals.....	4300
Section 4310	Construction Scheduling	4310
Section 4322	Photographic Documentation.....	4322
Section 4370	Schedule of Values.....	4370
Section 4400	Quality Control.....	4400
Section 4465	Testing and Startup	4465
Section 4480	Tightness Testing of Concrete Structures	4480
Section 4500	Temporary Facilities	4500
Section 4562	Dust Control	4562
Section 4580	Project Identification Signs.....	4580
Section 4600	Delivery Storage and Handling	4600
Section 4612	Seismic Design Requirements.....	4612
Section 4614	Wind Design Criteria.....	4614
Section 4630	Substitutions and Product Options.....	4630
Section 4700	Contract Closeout.....	4700
Section 4710	Cleaning	4710
Section 4720	As-Built Drawings	4720
Section 4730	Operation and Maintenance Data and Training.....	4730
Section 4740	Warranties and Bonds	4740

PART I GENERAL PROVISIONS

SECTION 100

DEFINITIONS AND ABBREVIATIONS

100.1 TERMS. Unless otherwise stated, the words "direct," "required," "permitted," "ordered," "instructed," "designated," "considered," "necessary," "prescribed," "approved," "acceptable," "satisfactory," or words of like import, refer to actions, expressions and prerogatives of the Engineer.

100.2 DEFINITIONS.

Addenda. Written or graphic instruments issued prior to the opening of Bids which clarify correct, or change the Bidding Documents.

Advertisement. A public announcement inviting bids containing the location and description of the work, time and place of opening bids.

Asbestos. Any material that contains more than one percent asbestos or is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

As-Built Drawings. Annotated Drawings, which have been revised to reflect any changes during construction including unforeseen site conditions.

Bid. The offer of a responsible and responsive Bidder that was submitted to the Department on the Bid Forms, in accordance with the Bidding Documents. The bid shall be binding after expiration of the 48 hour waiting period.

Bidder. The individual or entity who submits a Bid directly to City.

Bidding Documents. The Invitation For Bid (IFB), Special Conditions for Streets/Drainage and Water/Sewer, the Bid Forms with any supplements, Standard Specifications for Infrastructure Improvements, Standard Plans, Drawings, Technical Specifications, and the proposed Contract Documents (including all Addenda).

Bid Forms. Louisiana Uniform Public Works Bid Forms and Bid Bond Form as developed by the Office of Facility Planning and Control.

Change Order. Any contract modification that includes an alteration, deviation, addition, or omission to the Contract, which authorizes an adjustment in the Contract Amount, Contract Time, or an addition, deletion, or revision of the Work.

City. The City of Shreveport, Louisiana for whom the work is being performed.

City Engineer. The Department Head of the Department of Engineering and Environmental Services.

Claim. A demand or assertion by City or Contractor seeking an adjustment of Contract Amount or Contract Time, or both, or other relief with respect to the terms of the Contract.

Closed Specification. A product specified to the exclusion of all other products of apparent equal quality and utility

Conformed Documents. An assembly of Contract Documents with the Contractor's completed Bid Forms, Bonds, Certificates of Insurance, and other forms furnished with the Bidding Documents; executed Contract; addenda and revised drawings and specifications incorporating changes made by addenda.

Contract. The entire and integrated written agreement between the City and the Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or Contracts whether written or oral.

Contract Bond. The approved form of security, executed by the Contractor and its surety of sureties, guaranteeing complete execution of the contract and all supplemental Contracts pertaining thereto and the payment of all legal debts pertaining to the construction of the project.

Contract Documents. Those items so designated in the Contract. Only printed or hard copies of the items listed in the Contract are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

Contract Item (Pay Item). A specific unit of work for which a price is provided in the Contract.

Contract Amount. The moneys payable by City to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Contract subject to the provisions of Section 101 in the case of Unit Price Work.

Contract Time. The number of working days or dates stated in the Contract to achieve Milestones, if any, and complete the Work so that it meets the requirements of completion as evidenced by written recommendation by Engineer.

Contractor. The individual or entity with whom City has entered into the Contract.

Controlling Item of Work. An item of work that should be in progress at the time, essential to the orderly completion of the work within the time limit specified, in accordance with the Contractor's approved progress schedule.

Department. The term shall mean "Department of Public Works," "Department of Water and Sewerage," "Department of Engineering and Environmental Services (EES)" or its authorized representative.

Drawings. The part of the Contract Documents prepared or approved by the Engineer which shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

Effective Date of the Contract. The date indicated in the Contract on which it becomes effective, but if no such date is indicated, it means the date on which the Contract is signed and delivered by the last of the two parties to sign and deliver.

Engineer. The City Engineer of the Department of Engineering and Environmental Services (EES) or their authorized representative.

Equipment. All machinery, equipment, tools and apparatus necessary for acceptable completion of the work.

Extra Work. An item of Work not provided for in the Contract as awarded but found essential to the satisfactory completion of the Contract within its intended scope.

Field Order. A written order issued by the Engineer and signed by the Contractor which requires minor changes in the Work but which does not involve a change in the Contract Amount or the Contract Time.

Final Acceptance. After receipt of a clear lien certificate, Final Acceptance will be approved by the City and a letter of Final Acceptance will be issued to the Contractor and retainage will be paid.

Final Completion. A letter of Final Completion will be issued by the City to the Contractor when all contract work has been completed, the final inspection has been performed and no incomplete or unsatisfactory work is outstanding. Accrual of Contract Time ends and time for the maintenance bond begins when Final Completion has been achieved.

Final Inspection. Contractor will notify the City in writing that the work is ready for final inspection. The Contractor's notice will be signed by the Engineer at least 10 days prior to the final inspection. The final inspection uncovers any work that is incomplete or unsatisfactory, The Engineer will give the Contractor written instruction for correction.

General Requirements. Technical Specifications for certain administrative requirements and procedural matters.

Hazardous Environmental Condition. The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

Hazardous Waste. The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

Holiday or Legal Holiday. Any calendar day observed or authorized by the City as a non-working holiday.

Incidental Work. Work required by the contract for which no direct payment is provided.

Inspector. An individual authorized to inspect all Work and materials.

Intent to Award. The written notice by City to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, City will sign and deliver the Contract.

Laboratory. A testing laboratory approved by the City.

Laws and Regulations. Any and all applicable laws, rules, regulations, ordinances, codes, and other of any and all governmental bodies, agencies, authorizes, and courts having jurisdiction.

Liens. Changes, security interests, or encumbrances upon Project funds, real property, or personal property.

Manual of Uniform Traffic Control Devices (MUTCD). The manual adopted by the City for a uniform system of traffic control devices used on public roadways.

Materials. Any substances used in the Work.

Milestones. A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Final Completion all the Work.

Notice to Proceed. A written notice given by City to Contractor fixing the date on which the Contract Time will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

Open Specification. A product specified by a particular brand, make, or manufacturer only to convey the general style, type, character, and quality of the product desired.

PCBs. Polychlorinated biphenyls.

Parish. Parish of Caddo, Louisiana.

Pay Estimate. Documentation prepared by the Engineer from daily reports listing quantities of Contract Items and percentages of work items in the schedule of values completed during each working day.

Petroleum. Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste.

Plans. Drawings.

Profile Grade. The trace of a vertical plane intercepting the top surface of the original or proposed surface grade usually along the centerline of the roadbed, pipeline or channel.

Progress Schedule. A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Time.

Project. The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

Project Engineer. An authorized representative of the Engineer who is in charge of the project.

Proposal. The written offer of the Bidder to perform the contemplated Work and furnish the necessary materials, when made out and submitted on the prescribed Bid Forms, properly signed and guaranteed.

Proposal Guaranty. Certified check, cashier's check, money order, or Bidder's surety bond executed by a bona fide surety company, accompanying the Bid as a guaranty that the Bidder, if awarded the Contract, will enter into a Contract with the City for the performance of the Work.

Qualified Products List. Lists maintained by the Department's materials and testing section for products which do not lend themselves to the preparation of meaningful specifications, or for which repetitive full testing is too time consuming or expensive to be practical for routine project control.

Quality Control/Quality Assurance (QC/QA). The program used jointly by the Contractor and the Department to monitor Material Selections and production and Project construction to ensure that the product continuously and uniformly conforms to the Plans and

Specifications. Quality Assurance is the process used by the Department to inspect, sample and test, and accept the Contractor's work.

Radioactive Material. Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

Reference Specifications. Bulletins, standards, rules, methods of analysis or test, codes and specifications of other agencies, engineering societies, or industrial associations referred to in those specifications. All such references specified herein, refer to the latest edition thereof, unless otherwise specified, including any amendments thereto which are in effect and published at the time of advertising for bids.

Resident Project Representative. The authorized representative of Engineer who may be assigned to the Site or any part thereof.

Roadbed. The graded portion of a street or highway within top and side slopes, prepared as a foundation for pavement structure and shoulders.

Roadside. A general term denoting the area adjoining the outer edge of the Roadbed within the right of way. Extensive areas between the Roadways of a divided street or highway may also be considered roadside.

Roadway. That portion of the right of way included between the outside lines or slopes, gutters, or side ditches, including also the appurtenant structures, and all slopes, ditches, channels, waterways, etc., necessary to proper drainage and protection.

Samples. Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which established that standards by which such portion of the Work will be judged.

Schedule of Submittals. A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

Schedule of Values. A schedule, prepared and maintained by Contractor, allocating portions of the Contract Amount to various portions of the Work and used as the basis for reviewing Contractor's Pay Estimate.

Sewer. Any conduit intended for the reception and carrying of domestic sewage and industrial waste.

Shop Drawings. All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

Site. Lands or areas indicated in the Contract Documents as being furnished by City upon which the Work is to be performed, including right-of-way and servitudes for access thereto, and such other lands furnished by City which are designated for the use of Contractor.

Special Provisions. Specific clauses setting forth conditions or requirements peculiar to the Work, and that modify or supplement the standard and reference specifications.

Specialty Item. An item indicated in the Contract Documents which is not normally associated with the primary type of construction included in the Contract Documents and

requires highly specialized knowledge, abilities or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the Contract.

Technical Specifications. That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

Specifications. This term includes the standard specifications and specifications included herein by reference.

Standard Plans. A set of details developed by the City as a guide to fabricating or constructing various structures.

Standard Drawings. Drawings of structures or devices referred to on the Plans or in Specifications by title and/or an index number.

Standard Work Week. The standard work hours for City work is 7:30a. to 4:30pm, unless otherwise approved in writing by the Engineer, Monday through Friday, excluding Saturday, Sunday and City observed Holidays.

State. The State of Louisiana.

Stockpiled Materials. Materials used for constructing City projects that are located on or near the Project Site or other approved location.

Storm Drain. Any conduit intended for the reception and carrying of storm water and surface water, street wash and other wash waters, or drainage, but excludes sewage and industrial waste; also called "storm sewer". Also may include open channel type of storm drain.

Street. Any road, highway, parkway, freeway, alley, walk, or way, including all area within the right-of-way.

Structures. Bridges, culverts, catch basins, junction boxes, retaining walls, cribbing, manholes, endwalls, buildings, sewers, water mains, service pipes, underdrains, foundation drains and other similar features encountered in the Work.

Subcontractor. Any individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site. Any individual, partnership, corporation, limited liability company, or any other legal entity shall not be considered to be a subcontractor if it is a subsidiary which is wholly owned or majority owned by the Contractor, or an affiliate of the Contractor or affiliated or otherwise controlled by the Contractor or the principals of the Contractor such that a true and independent subcontractor-contractor relationship reached by bidding or arms-length negotiation does not result therefrom.

Subgrade. The top surface of a Roadbed upon which the pavement Structure and shoulders are constructed.

Substructure. The portion of the Structure below the bearings of simple and continuous spans, skew backs or arches and tops of footings of rigid frames, including back walls, and wing walls.

Successful Bidder. The Bidder submitting a responsive and responsible Bid to whom City makes an award.

Superintendent. The agent of the Contractor on the Work at all times, with capability and authority as required by the Contract Documents.

Supplier. A manufacturer, fabricator, supplier, distributor, material man, or vendor having direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

Surety. The bondsman, party or parties who may guarantee the fulfillment of the Contract by bond.

Underground Facilities. All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other controls systems.

Unit Price Work. Work to be paid for on the basis of unit prices.

Utility. Tracks, overhead or underground wires, pipe lines, conduits, ducts, or structures, owned, operated, or maintained in or across a public right-of-way or private easement. The word "utility" used herein, shall mean either the owner of the utility or the utility itself, whichever is applicable.

Work. The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

Working Day. A calendar day during which construction operations could proceed for a major part of a shift, normally excluding Saturday, Sunday and City observed Holidays.

Work Change Directive. A Change Order authorizing an addition, deletion, or revision of the Work, but not an adjustment in Contract Amount or Contract Time. A Work Change Directive is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequent Change Order following negotiations by the parties as to its effect, if any, on the Contract Amount or Contract Time.

100.3 TERMINOLOGY.

The words and terms discussed herein are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

- a. **Intent of Certain Terms or Adjectives:** The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the

performance of the Work, or any duty or authority to undertake responsibility contrary to any provision of the Contract Documents.

- b. **Day:** The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- c. **Defective:** The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents; or
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by City at Final Completion).
- d. **Furnish, Install, Perform, Provide:**
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- e. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

100.4 ABBREVIATIONS.

AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ABS	Acrylonitrile - butadiene - styrene
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWPA	American Wood Preservers Association
AWS	American Welding Society

AWWA	American Water Works Association
C	Degree on Celsius temperature scale
CC	Center to Center
CF	Cubic Foot
CM	Centimeter
CMP	Corrugated Metal Pipe
COE	Corps of Engineers
CRSI	Concrete Reinforcing Steel Institute
Cu.	Cubic
CWT	Hundred Weight
Deg	Degree or degrees
DEQ	Louisiana Department of Environmental Quality
Dia	Diameter
DOS	Department of Operational Services
DOTD	Louisiana Department of Transportation and Development, Office of Highway
E	East
EPA	Environmental Protection Agency
F	Degree on Fahrenheit Temperature Scale
FAA	Federal Aviation Association
Fed. Spec.	Federal Specification
Ft.	Foot or feet
Ga.	Gallon
Galv	Galvanized
ICC	Interstate Commerce Commission
IMSA	International Municipal Signal Association
IPCEA	International Power Cable Engineers Association
ITE	Institute of Traffic Engineers
Kg.	Kilogram
L	Liter
L.S.	Lump Sum
T	Thousand
Max.	Maximum
Min.	Minimum
MI.	Milliliter
Mm	Millimeter
MUTCD	Manual of Uniform Traffic Control Devices
N	North or Newton
NA	Not Applicable
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OD	Outside diameter
OSHA	Occupational Safety and Health Administration
Pa	Pascal
psi	Pounds per square inch
PVC	Polyvinyl chloride
RCP	Reinforced Concrete Pipe
RMA	Rubber Manufacturers Association
S	South
SDR	Standard thermoplastic pipe dimension ratio (ratio of pipe O.D. to minimum wall thickness)
Sq.	Square
SSPC	Steel Structures Painting Council
T	Ton
UL	Underwriters Laboratories, Inc.

USDA	United States Department of Agriculture
W	West
XCU	Explosion, collapse, underground obstacles
Yd.	Yard(s)

SECTION 101

BIDDING REQUIREMENTS

101.1 SITE CONDITIONS. Logs of test holes, ground water levels, and any accompanying soil, geological, or seismic reports as furnished by the Engineer are furnished for general information only. The field conditions so set forth shall not constitute a representation or warranty, expressed, or implied that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions, both above and below ground.

101.2 QUANTITIES AND UNIT PRICES. The quantities for which unit prices are indicated in the proposal do not constitute a warranty nor guarantee by the Engineer that the quantities so indicated are the actual quantities required for the work under the contract. The Engineer reserves the right to increase or decrease the quantities of work and materials under unit price pay items as outlined in Section 105 hereof, provided that said increase or decrease does not materially change the intent of the basic contract.

101.2.1 Approximate Quantities. The quantities appearing in the bid schedule are approximate only and will be used for the purpose of comparison of bids and the summation of the prices bid will determine the required amount of the proposal guaranty and the contract bond.

101.2.2 Changes in Estimated Quantities. Scheduled quantities of work to be done and materials to be furnished may each be increased, diminished, or omitted as herein provided, without in any way invalidating the prices bid.

101.2.3 Actual Quantities. Payment to the Contractor will be made only for the actual quantities of work performed and accepted, or materials furnished in accordance with the contract.

101.2.4 Unit Prices or Lump Sum Pay Items. Work and materials, equipment and equipment rental will be paid for in accordance with the unit prices or lump sum pay items appearing in the proposal and contract. In the event no unit price nor lump sum pay item is provided for any specific item or work, material or equipment required under the contract, it will be considered as having been included by the Contractor in the prices bid for the pay items appearing in the proposal and contract.

Estimated quantities, if listed on drawings for any structure or item of work, are for the convenience of the Contractor. Such estimated quantities shall not be construed as pay items and the Engineer assumes no responsibility for their accuracy.

101.2.5 Special Limitations. Bid prices submitted will be limited to one hundredth of a cent or more. If prices are submitted, carried to amounts less than one hundredth of a cent, the amount will be truncated and only that portion of the amount one hundredth of a cent or greater will be used. Quantities will be measured only to the nearest one hundredth of a unit. Extension amount calculations will be rounded off to the whole cent.

101.3 MATERIAL GUARANTY. The successful bidder may be required to furnish a complete statement of the origin, composition and manufacture of any or all materials to be used in the construction of the work together

with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.

SECTION 102

AWARD AND EXECUTION OF CONTRACT

102.1 CONSIDERATION OF PROPOSALS. After the Bids are opened and read, they will be compared on the basis of the sum of the base bid and any alternates accepted. The results of such comparisons will be available to the public.

The right is reserved to reject any or all Bids, or to advertise for new Bids if, in the judgment of the awarding authority, the best interests of the City will be promoted thereby.

102.2 AWARD OF CONTRACT. The award of a contract, if it will be awarded, will be made within 45 calendar days after the opening of Bids to the lowest responsible and responsive Bidder. The Successful Bidder will be notified of the Intent to Award.

102.2.1 Ordinance No. 114 or 1990. In accordance with this ordinance, the following applies:

1. On every contract to which the City is a party and for which written specifications are prepared, the specification shall include the requirement that before the contract is awarded, the Contractor shall pay all taxes, licenses, fees, and other charge which are outstanding and due to the City.
2. No contract to which the City is a party shall be awarded to any person who has not paid all taxes, licenses, fees and other charges which are outstanding and due the City.

102.2.2 Submittal of Additional Information. The apparent low Bidder shall submit additional information to the City within 10 days after the bid opening. This information shall include, but is not limited to, a complete list of proposed Subcontractors, with the dollar amount and percentage of labor to be performed by each Subcontractor. List shall include the dollar amount and percentage of labor to be performed by Contractor. Total of all percentages must equal 100 percent.

102.3 CANCELLATION OF AWARD. The City reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties without any liability against the Department.

102.4 RETURN OF PROPOSAL GUARANTY. All proposal guaranties of unsuccessful bidders will be returned to them within 15 days after the opening of the bids. The retained proposal guaranty of the successful bidder will be returned after a satisfactory bond has been furnished and the contract has been executed.

102.5 CONTRACT BOND. Prior to the execution of the contract, the Contractor shall file with the City, a surety bond, on a form provided or approved by the City, in the amount and for the purposes noted below, duly executed by a responsible corporate surety authorized to issue such bonds in the State of Louisiana. The Contractor shall pay all premiums and costs thereof and incidental thereto. The bond must be signed by both the Contractor and surety, and the bond shall be in the sum of not less than 100% of the contract price to assure the claims of material men supplying materials to him, and of mechanics and laborers employed by him on the work required under these specifications and to assure the faithful performance of the contract.

The bond shall be so conditioned as to assure the faithful performance by the Contractor of all work under said contract within the time limit prescribed in a manner that is satisfactory and acceptable to the City; that all materials and workmanship supplied by him will be free from original or developed defects; and that should original or developed defects or failures appear prior to the date of acceptance of the work by the City, the Contractor shall at his own expense make good such defects and failures and make

all replacements and adjustments required, within a reasonable time after being notified by the Department to do so, and to the approval of the City. This bond shall be maintained by the Contractor in full force and effect during the performance of the work of the Contractor, and until the date of acceptance of the work by the City, and until all claims for materials and labor are paid, subject to local ordinances and lien laws of the State of Louisiana.

Should any surety of sureties upon said bond or any of them become insufficient, the Contractor shall renew said bond with good and sufficient sureties within ten days after receiving notice from the City.

102.6 EXECUTION AND APPROVAL OF CONTRACT. The Contract shall be signed by the Successful Bidder and returned, together with the contract bond, within 15 days after the contract has been sent to the Successful Bidder. If the contract is not executed by the City within 60 days after Intent to, the Successful Bidder shall have the right to withdraw its bid without penalty. No contract shall be considered as effective until it has been fully executed by all of the parties thereto.

102.7 FAILURE TO EXECUTE CONTRACT. Failure to execute the contract and return acceptable bond within fifteen 15 days after the Contract has been sent to the Successful Bidder may be cause for cancellation of the Intent to Award and forfeiture of the proposal guaranty which shall become the property of the City, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible and responsive Bidder or the Project may be re-advertised and constructed under Contract, as the City may decide.

102.8 FAILURE TO ISSUE NOTICE TO PROCEED. Should the Notice to Proceed not be issued within 30 days after the execution of the Contract, the Contractor may at any time thereafter demand cancellation of the Contract prior to issuance of Notice to Proceed.

102.9 PRELIMINARY MATTERS.

102.9.1 Evidence of Insurance: Before any Work is started, Contractor shall deliver to the City, with copies to each additional insured identified in the Contract Documents, certifications of insurance (and other evidence of insurance which the City or any additional insured may reasonably request) which Contractor is required to purchase and maintain.

102.9.2 Commencement of Contract Time; Notice to Proceed: The Contract Time will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after execution of the Contract. In no event will the Contract Time commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after execution of the Contract, whichever date is earlier.

102.9.3 Starting the Work: Contractor shall start to perform the Work on the date when the Contract Time commences to run.

102.9.4 Preliminary Schedules: Within 10 days after the Effective Date of the Contract (unless otherwise specified in the General Requirements), Contractor shall submit to City for timely review:

1. An Interim Schedule as specified in Technical Specification Section 4310 Construction Scheduling;
2. a preliminary Schedule of Submittals; and
3. a preliminary Schedule of Values for all of the Work which includes lump sum quantities and prices of items which, when added together, equal the Contract Amount; and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

102.9.5 Preconstruction Conference: When scheduled by the City a conference attended by City, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the preliminary schedules, procedures for handling Shop Drawings and other submittals, processing Pay Estimates, and maintaining required records.

At this conference City and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

102.9.6 Initial Acceptance of Schedules: At least 10 days before submission of the first Pay Estimate a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Technical Specification Section 4310 Construction Scheduling and Technical Specification Section 4370 Schedule of Values. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Time. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Amount to component parts of the Work.

SECTION 103

SCOPE OF WORK

103.1 INTENT OF CONTRACT. The intent of the contract is to provide for performance and completion of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the Work in accordance with the plans, project specifications and terms of the contract. When an item in the contract contains a choice to be made by the Contractor, the Contractor shall indicate the choice to the Engineer in writing. When the project specifications reference or require the use of "manufacturer's recommendations or specifications," the Contractor shall provide the Engineer with a current copy of these recommendations or specifications.

103.2 ALTERATION OF THE CONTRACT. Without invalidating the Contract, City may, at any time or from time to time, order addition, deletion, or revision of Work by a Change Order or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided). Pay Items affected by such additions, deletions, or revisions shall be performed in accordance with the requirements of the Contract Documents, and payment will be made at the same unit prices as other parts of the Work, except as provided in Section 105.

City may order addition, deletion, or revision of Work and authorize adjustments to the Contract Amount and/or Contract Time in a formal Change Order. Engineer may order addition, deletion, or revision of Work, but may not authorize adjustments to the Contract Amount or Contract Time, in a Work Change Directive. A Work Change Directive is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequent Change Order following negotiations by the parties as to its effect, if any, on the Contract Amount or Contract Time.

Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract or the Contract Time and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer may order changes in details, including changes in materials, processes, and sequences.

These minor variations and changes in details may be accomplished by a Field Order and will be binding on City and also on Contractor, who shall perform the Work involved promptly. If City or Contractor believes that a Field Order justifies an adjustment in the Contract Amount or Contract Time, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Section 105.

The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

- a. Field Order
- b. Engineer's approval of a Shop Drawing or Sample (subject to provisions of Section 104)
- c. Engineer's written interpretation or clarification

Alterations to the contract as provided for by this section shall not invalidate the contract nor release the surety, and the Contractor agrees to accept the Work as altered, as if it had been part of the original contract. The Contractor shall notify the surety of any alterations to the contract. Alterations of the contract shall not involve work beyond the termini of the proposed work except as necessary to satisfactorily complete the project. Approval of all plan changes is subject to the approval and concurrence from the appropriate funding source. No plan change will be assumed to be approved until the signed and approved plan change is returned to the originator.

103.3 MAINTENANCE OF TRAFFIC. Reasonable provisions for local traffic through the length of the project and the life of the contract shall be made by the Contractor during construction, at no direct pay. When specified, the Contractor may also be required to provide for through traffic over the entire project, or designated portion thereof, at no direct pay. The Contractor shall keep the portion of the project being used by public traffic, whether through or local traffic, in such condition that traffic (including mail delivery) will be adequately accommodated. The Contractor shall furnish, erect and maintain barricades, warning signs and delineators, and shall provide flaggers and pilot cars in accordance with the plans and the MUTCD. The Contractor shall also provide and maintain in a safe condition all temporary approaches or crossings, intersections with roads, streets, businesses, parking lots, residences, garages and farms, at no direct pay. When the Engineer directs additional measures for the benefit of the traveling public, payment to the Contractor will be made at the contract unit prices in the contract. The Engineer will be the judge of work to be classed as additional measures.

103.4 FINAL CLEANING UP. Before final completion, the right-of-way, borrow and local material sources, and areas occupied by the Contractor in connection with the work shall be cleaned of rubbish, excess materials, temporary structures, haul roads and equipment. All parts of the work, including property adjacent to the right-of-way, which have been damaged or rendered unsightly during the work shall be left in satisfactory condition and when required, the right-of-way shall be mowed in accordance with City maintenance standards, all at no direct pay.

103.5 GUARANTEES. The Contractor guarantees, by signing the contract, mechanical and electrical equipment, apparatus, materials and workmanship provided under the contract for a period of two years after final completion on projects not involving federal funds and six months on 28 Federal-Aid Projects. Instruction sheets that are required to be furnished by the manufacturer for materials, supplies, and operation shall be delivered by the Contractor to the Engineer prior to final completion of the project, with the following written warranties and guarantees:

1. The manufacturer's standard warranty for each piece of mechanical and electrical equipment or apparatus furnished under the contract.
2. The Contractor's guarantee that, during the guarantee period, necessary repair or replacement of the warranted equipment or apparatus will be made by the Contractor at no direct pay.
3. The Contractor's guarantee for satisfactory operation of the mechanical and electrical systems furnished and constructed under the contract for the guarantee period.

103.6 DIFFERING SITE CONDITIONS, SUSPENSIONS OF WORK, AND SIGNIFICANT CHANGES IN THE CHARACTER OF THE WORK.

A. Differing Site Conditions:

1. During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.
2. Upon written notification, the Engineer will investigate the conditions and if he determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding loss of anticipated profits, will be made and the contract modified in writing accordingly. The Engineer will notify the Contractor of his determination whether or not an adjustment of the contract is warranted.

3. No contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.
4. The presence of ground water does not constitute differing site conditions. The Contractor should expect to encounter ground water during normal excavation operations.

B. Suspensions of Work Ordered by the Engineer.

1. If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary or inherent to the construction industry) and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment within 7 calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.
2. Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost and/or time required for the performance of the contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors, and not caused by weather, the Engineer will make an adjustment (excluding profit) and modify the contract in writing accordingly. The Engineer will notify the Contractor of his determination whether or not an adjustment of the contract is warranted.
3. No contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.
4. No contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this contract.

C. Significant Changes in the Character of Work.

1. The Engineer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the Contractor agrees to perform the work as altered.
2. If the alterations or changes in quantities significantly change the character of the work under the contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Engineer may determine to be fair and equitable.
3. If the alterations or changes in quantities do not significantly change the character of the work to be performed under the contract, the altered work will be paid for as provided elsewhere in the contract.
4. The term "significant change" shall be construed to apply only to the following circumstances:

- a. When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or;
- b. When a major item of work, as defined elsewhere in the contract, is increased, or decreased, in excess of 25 percent of the contract quantity as awarded. Any adjustment in unit price will be made on only that portion of the major item exceeding the 25 percent increase, or, in the case of a decrease of the item by 25 percent or more, the remaining portion will be adjusted.
- c. Where conflicts exist between these requirements and other sections of the specifications, these requirements will govern.

SECTION 104

CONTROL OF WORK

104.1 AUTHORITY OF THE ENGINEER. The Engineer will decide the following: all questions which arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which arise as to the interpretation of the plans and specifications; and all questions as to the acceptable fulfillment of the contract on the part of the Contractor. The Engineer will have the authority to suspend the work wholly or in part due to the following: failure of the Contractor to correct conditions unsafe for workmen or the general public; failure to carry out provisions of the contract; failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

All orders to suspend the work shall be in writing and shall include the specific reasons for the suspension. The order to resume work shall also be in writing.

104.2 PLANS AND SPECIFICATIONS.

104.2.1 General. The Contractor will be supplied without charge five (5) sets of contract documents. The Contractor shall keep at the work site a copy of the plans and specifications and shop drawings to which the Engineer shall have access at all times.

If the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications but that reasonably acceptable work has been produced, he shall make a determination if the work will be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary.

If the Engineer finds the materials furnished, work performed, or the finished product is not in reasonably close conformity with the plans and specifications and has resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by, and at the expense of, the Contractor.

While it is believed that much of the information pertaining to conditions which may affect the cost of the proposed work will be shown on the plans or indicated in the specifications, the City does not warrant the completeness or accuracy of such information. It is the Contractor's responsibility to ascertain the existence of any conditions affecting the cost of the work which would have been disclosed by reasonable examination of the site.

Existing improvements visible at the job site, for which no specific disposition is made on the plans, but which could reasonably be assumed to interfere with the satisfactory completion of the improvements contemplated by the plans, shall be removed and disposed of by the Contractor upon written approval of the Engineer.

Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier,

then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Section 105.

Contractor shall not be liable to City for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

104.2.2 Resolving Discrepancies.

Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

- a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
- b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

Any conflict, error, ambiguity, or discrepancy within the Contract Documents shall be resolved with the following order of precedence, with the first document having the highest order. The document higher in order of precedence shall govern.

1. Change Orders
2. Work Change Directives
3. Field Orders
4. Technical Specifications
5. Drawings
6. Special Provisions
7. General Requirements
8. Standard Specifications
9. Reference Specifications

104.2.3 Shop Drawings and Samples.

Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as specified in the General Requirements. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

104.2.3.1 Shop Drawings.

- a. Submit number of copies specified in Technical Specification Section 4300 Submittals.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to

enable Engineer to review the information for the limited purposes as provided in this Section.

104.2.3.2 Samples.

- a. Submit number of Samples specified in Technical Specification Section 4300 Submittals.
- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which it is intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes as provided in this Section.

104.2.3.3 Submittal Requirements.

Before submitting each Shop Drawing or Sample, Contractor shall have:

- a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
- b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
- c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
- d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

Each submittal shall bear a stamp or specific written certification as specified in Technical Specification Section 4300 Submittals.

With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

104.2.3.4 Engineer's Review.

Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the

requirements of the Contract Documents unless Contractor has complied with the requirements of Subsection 104.2.3.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the Submittal Procedures.

104.2.3.5 Resubmittal Procedures.

Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

104.3 COOPERATION BY CONTRACTOR. The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors and other Contractors in every way possible.

The Contractor shall have on the work at all times, as his agent, a competent superintendent capable of reading and understanding the plans and specifications and experienced in the type of work being performed, who shall receive instructions from the Engineer or his authorized representatives. The superintendent shall have authority to execute orders or directions of the Engineer without delay and to promptly supply such materials, equipment, tools, labor and incidentals as required. Such superintendence shall be furnished regardless of the amount of work sublet. The Superintendent shall furnish telephone contact information and be available by telephone 24 hours each day for response to the City Engineer in emergency situations within a two (2) hour time frame. Failure to respond to an emergency situation within a reasonable time will result in the City correcting the situation and withholding the cost of equipment, material and labor from the Contractor's monthly payment.

The Contractor shall certify to the Engineer, by written notice, the names of persons authorized to sign for him in all matters pertaining to the changing of plans, force account or extra work, contract time charges and other fiscal documents. No work shall commence on the project until the Contractor has complied with this requirement. Such written notice shall also be furnished whenever a person so designated is removed and replaced on the project.

104.4 COOPERATION BETWEEN CONTRACTORS. The City reserves the right at any time to contract for and perform additional work on or near the work covered by the contract. When separate contracts are let within the limits of one project, each Contractor shall conduct his work so as not to hinder the progress of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor shall assume all liability, financial or otherwise, in connection with his contract and shall indemnify the City from all damages or claims that may arise because of inconvenience, delay or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project. The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

104.5 CONSTRUCTION LAYOUT.

104.5.1 General. Contractor shall provide field engineering services as specified in Technical Specification Section 4050 Project Controls.

104.5.2 Reference Points. City shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior

written approval of City. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

104.5.3 Highways and Bridges. The provisions of this subsection are in addition to those specified in the General Requirements, and apply to Work for roadway and bridge construction. Contractor shall employ sufficient qualified surveying or engineering personnel experienced in layout and construction of highways and bridges to correctly establish and keep complete and comprehensive notebook records of all lines and grades necessary from initial layout to final acceptance. The Contractor will be liable for the accuracy of the initial layout and all subsequent alignment and elevations and shall, at his own expense, rebuild, repair or make good any portion of the Work found to be incorrectly positioned either horizontally or vertically at any time before final acceptance. The Contractor shall compute and provide template grades to the Engineer as soon as possible in order to obtain pipe lengths in an orderly manner. This Work shall include, but is not limited to, staking for the relocation of utilities, all staking for the complete construction of the Project and any miscellaneous information required by the project Engineer. Numbered notebooks for recording of all lines and grades will be provided by the City and shall be properly indexed and cross referenced by the Contractor before return to the Engineer for submittal with the final estimate.

104.6 DUTIES OF THE INSPECTOR. Inspectors employed by the City will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor; however, he shall have the authority to reject work or materials until any question at issue can be referred to and decided by the Engineer.

104.7 INSPECTION OF WORK. All material and each part or detail of the work shall be subject to inspection by the Engineer. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. If the Engineer requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; however, should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed, will be at the Contractor's expense. Any work done or materials used without supervision or inspection by an authorized City representative may be ordered removed and replaced at the Contractor's expense.

When any unit of government or political subdivision or any railroad corporation is to pay a portion of the cost of the work covered by the contract, its respective representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision or any railroad corporation a party to the contract and shall in no way interfere with the rights of either party thereunder.

104.8 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. All work which does not conform to the requirements of the contract will be considered as unacceptable, unless otherwise determined acceptable under the provisions in Subsection 104.2. Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to final acceptance of the work shall be removed and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given except as

herein specified or any extra work done without authority will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed and/or replaced at the Contractor's expense.

Upon failure of the Contractor to comply forthwith with any order of the Engineer made under the provisions of this Subsection, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs from payments due or to become due the Contractor.

104.9 LOAD RESTRICTIONS. The Contractor and his subcontractors and suppliers shall comply with all legal load restrictions in the hauling of materials or equipment and on completed bridge structures, bases and pavements within the limits of the project. A special permit will not relieve the Contractor of liability for damage resulting from moving of material or equipment. In no case shall the legal load limits be exceeded unless permitted in writing.

The operation of equipment on the project of such weight or height or so loaded as to cause damage or overstress to structures or the roadway or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. The Contractor shall be responsible for all damage done by his hauling equipment.

104.10 MAINTENANCE DURING CONSTRUCTION. The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted daily with adequate equipment and forces to keep the roadway or structures in satisfactory condition at all times. In the case of a contract for the placing of a course on a previously constructed course or subgrade, the Contractor shall maintain the previous course or subgrade during all construction operations.

104.11 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE. If the Contractor fails to comply with Subsection 104.10, the Engineer will immediately notify the Contractor in writing of such noncompliance. If the Contractor fails to remedy the condition within 24 hours after receipt of the written notice, the Engineer may immediately remedy the condition, and the cost thereof will be deducted from payments for the work. When the condition requires more immediate remedy due to hazard to life, health and property, the Engineer may immediately remedy the condition and the costs thereof will be deducted from payments for the work.

Except as provided elsewhere in these specifications, all cost of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various pay items and the Contractor will not be paid an additional amount for such work.

104.12 PROJECT MEETING. Contractor shall arrange for all appropriate representatives of Contractor, Subcontractors, and Suppliers to prepare for and attend meetings specified in Technical Specification Section 4200 Project Meetings. Contractor shall provide documents and information as appropriate to the agenda.

SECTION 105

CHANGES IN WORK

105.1 CHANGES REQUESTED BY THE CONTRACTOR.

105.1.1 General. Changes in specified methods of construction may be made at the Contractor's request when approved in writing by the Engineer.

Changes in the plans and specifications, requested in writing by the Contractor, which do not materially affect the work and which are not detrimental to the work or to the interests of the City, may be granted by the Department to facilitate the work, when approved in writing by the Engineer.

105.1.2 Change Requested by the Contractor. If such changes are granted, they shall be made at a reduction in cost or at no additional cost to the City. Nothing herein shall be construed as granting a right to the Contractor to demand acceptance of such changes.

105.2 CHANGES INITIATED BY THE CITY.

105.2.1 General. The City may change the plans, specifications, character of the work, or quantity of work provided the total arithmetic dollar value of all such changes, both additive and deductive, does not exceed 25 percent of the contract price. Should it become necessary to exceed this limitation, the change shall be by written supplemental agreement between the Contractor and the City.

Change orders shall be in writing and state the dollar value of the change or establish method of payment, any adjustment in contract time, and, when negotiated prices are involved, shall provide for the Contractor's signature indicating acceptance.

105.2.2 Payment for Changes Initiated by the City

105.2.2.1 Contract Unit Prices. If a change is ordered in an item of work covered by a contract unit price, and such change does not involve a substantial change in the character of the work from that shown on the plans or included in the specifications, an adjustment in payment will be made based upon the increase or decrease in quantity and the contract unit price. In the case of such an increase or decrease in a major bid item, the use of this basis for the adjustment of payment will be limited to that portion of the change which, together with all previous changes to that item, is not in excess of 25 percent of the total cost of such item based on the original quantity and contract unit price.

If a change is ordered in an item of work covered by a contract unit price and such change does involve a substantial change in the character of the work from that shown on the plans or included in the specifications, an adjustment in payment will be made in accordance with Subsection 105.2.2.3.

Should any contract item be deleted in its entirety, payment will be made only for actual costs incurred prior to notification of such deletion.

105.2.2.2 Stipulated Unit Prices. Stipulated unit prices are those established by the City in the contract documents, as distinguished from contract unit prices submitted by the Contractor. Stipulated unit prices may be used for the adjustment of contract changes.

105.2.2.3 Agreed Prices. Adjustments in payments for changes other than those set forth in Subsection 105.2.2.1 and 105.2.2.2 will be determined by agreement between the Contractor and the City. If unable to reach an agreement, the City may direct the Contractor to proceed on the basis of Extra Work in accordance with Subsection 105.3.

105.3 EXTRA WORK.

105.3.1 General. New or unforeseen work will be classed as "extra work" when the Engineer determines that it is not covered by contract unit prices or stipulated unit prices.

105.3.2 Payment.

105.3.2.1 General. When the price for the extra work cannot be agreed upon, the City will pay for the extra work based on the accumulation of costs as provided in Subsection 105.4.

105.3.2.2 Daily Reports by Contractor.

- a. General. At the close of each working day, the Contractor shall submit a daily report to the Engineer, on forms approved by the City, together with applicable delivery tickets, listing all labor, materials, and equipment involved for that day, and for other services and expenditures when authorized. An attempt shall be made to reconcile the report daily, and it shall be signed by the Engineer and the Contractor. In the event of disagreement, pertinent notes shall be entered by each party to explain points which cannot be resolved immediately. Each party shall retain a signed copy of the report. Reports by subcontractors or others shall be submitted through the prime Contractor.
- b. Labor. The report shall show names of workers, classification, and hours worked.
- c. Material. The report shall describe and list quantities of materials used.
- d. Equipment. The report shall show type of equipment, size, identification number, and hours of operation including loading and transportation, if applicable.
- e. Other Services and Expenditures. Other services and expenditures shall be described in such detail as the City may require.

105.3.2.3 Basis for Establishing Costs.

- a. Labor. The costs of labor will be the actual cost for wages prevailing locally for each craft or type of workers at the time the extra work is done, plus employer payments of payroll taxes and insurance, health and welfare, pension, vacation, apprenticeship funds, and other direct costs resulting from Federal, State or local laws, as well as assessments or benefits required by lawful collective bargaining agreements. The use of a labor classification which would increase the extra work cost will not be permitted unless the Contractor establishes the necessity for such additional costs. Labor costs for equipment operators and helpers shall be reported only when such costs are not included in the invoice for equipment rental.
- b. Materials. The cost of materials reported shall be at invoice or lowest current price at which such materials are locally available and delivered to the job site in the quantities involved plus sales tax, freight and delivery.

The City reserves the right to approve materials and sources of supply, or to supply materials to the Contractor if necessary for the progress of the work. No markup shall be applied to any material provided by the City.

- c. Tool and Equipment Rental. No payment will be made for the use of tools which no specific allowance is herein provided.

Regardless of ownership, the rates to be used in determining equipment rental costs shall not exceed listed rates prevailing locally at equipment rental agencies, or distributors at the time the work is

performed. The rental rates paid shall include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance, and all incidentals.

Necessary loading and transportation costs for equipment used on the extra work shall be included. If equipment is used intermittently and, when not in use, could be returned to its rental source at less expense to the City than holding it at the work site, it shall be returned, unless the Contractor elects to keep it at the work site at no expense to the City.

- d. Invoices. Vendors' invoices for material, equipment rental, and other expenditures, shall be submitted with the request for payment. If the request for payment is not substantiated by invoices or other documentation, the City may establish the cost of the item invoiced at the lowest price which was current at the time of the report.

105.3.2.3 Markup.

- a. Work by Prime Contractor. The following percentage shall be added to the Contractor's costs and shall constitute the markup for all overhead and profits.

Labor	20
Materials	15
*Equipment Rental	15
Other Items and Expenditures	15

****Rental rates must be agreed on prior to any work.***

To the sum of the costs and markups provided for in this Subsection, 6 percent shall be added as compensation for bond and liability insurance and tax. No allowance for general superintendents and small tools shall be made.

- b. Work by Subcontractor. When all or any part of the extra work is performed by any of the Contractor's subcontractors, the markups established in paragraph (a) above shall be applied to the subcontractor's actual cost of such work, to which a markup of 10 percent on less than \$50,000 and 5 percent on more than \$50,000 on the subcontracted portion of the extra work may be added by the prime Contractor.

When the labor markup percentage of "burden", which is submitted on change orders, exceeds 35% (thirty-five percent), the Contractor is required to document in full as to the actual cost of the burden.

105.4 CHANGED CONDITIONS. Contractor shall notify the Engineer in writing of the following work site conditions, hereinafter called changed conditions, promptly upon their discovery and before they are disturbed:

- a. Subsurface or latent physical conditions differing materially from those represented in the contract; and
- b. Unknown physical conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character being performed.

The Engineer will promptly investigate conditions when notified or any conditions discovered by him/her which appear to be changed conditions. If the Engineer determines that the conditions are changed conditions and that they will materially increase or decrease the costs of any portion of the work, a

change order will be issued adjusting the compensation for such portion of the work in accordance with Subsection 105.2.2. If the Engineer determines that conditions of which he/she has been notified by the Contractor do not justify an adjustment in compensation, the Contractor will be so advised in writing. Should the Contractor disagree with such determination, he may submit a notice of potential claim to the Engineer, as provided in Subsection 105.5.

If the Engineer determines that the conditions are changed conditions and that they will materially affect the performance time, the Contractor, upon submitting a written request, may be granted an extension of time subject to the provisions of Subsection 110.7.

The Contractor's failure to give notice of changed conditions promptly upon their discovery and before they are disturbed shall constitute a waiver of all claims in connection therewith.

105.5 DISPUTE RESOLUTION. If unable to reach an agreement on changes in Work, the City may direct the Contractor to proceed with the disputed Work. Although not to be construed as proceeding under extra work provisions, the Contractor shall keep and furnish records of disputed Work in accordance with Subsection 105.3.

All Claims shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by City or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the claimant. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Amount or Contract Time shall be prepared in accordance with the provisions of Section 105.5. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;
2. approve the Claim; or
3. notify that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied. Engineer's written action or denial pursuant to this subsection will be final and binding upon City and Contractor, unless within 30 days of such action or denial City or Contractor:

1. agrees to submit the Claim to another dispute resolution process; or
2. gives written notice of the intent to submit the Claim to a court of competent jurisdiction.

No Claim for an adjustment in Contract Amount or Contract Time will be valid if not submitted in accordance with this subsection.

105.6 VALUE ENGINEERING PROPOSALS. This provision is to share with the Contractor only the cost savings generated on this contract as a result of a Value Engineering (VE) Proposal(s) offered by the Contractor and approved by the City. Any time savings resulting from a VE Proposal will be considered at the completion of the project as an incentive to the Contractor, provided the contract contains an incentive clause for early completion of the work and the Contractor has not met the incentive limit in the contract. A time only reduction will not be considered as a VE Proposal. The purpose of the VE Proposal is to encourage the use of the Contractor's ingenuity and experience in arriving at alternative construction methods which will reduce the overall construction cost. After award of the contract, the successful bidder will be permitted to submit to the Engineer, written VE Proposals, for modifying the plans, specifications, or other requirements of the contract for the purpose of reducing the total cost of construction.

The VE Proposal shall not impair, in any manner, the essential functions and characteristics of the project, including but not limited to safety, service life, reliability, economy of operation, ease of maintenance, desired appearance, traffic flow during construction, or necessary standardized features. The VE Proposal shall be specifically identified by the Contractor as a cost reduction proposal. VE Proposals will be considered by the City in the same manner as plan changes.

The Contractor has the option of submitting a conceptual VE Proposal to the City for review prior to making formal submission. However, the Contractor may submit the formal VE Proposal directly. The conceptual VE Proposal shall provide the following minimum information:

1. A description of the proposal.
2. A listing of work items affected by the proposed change, including any change in contract time and/or traffic maintenance.
3. An initial estimate of the net cost savings which the change is expected to generate. The Contractor may proceed to the formal VE Proposal upon the City's approval of the conceptual VE Proposal. The City is not obligated to approve the Contractor's formal VE Proposal, even if the conceptual VE Proposal is initially considered acceptable. As a minimum, the following information shall be submitted by the Contractor with the formal VE Proposal:
 - a. A statement that the proposal is submitted as a VE Proposal.
 - b. A description of the difference between the existing contract requirements and the proposed change(s), and the comparative advantages and disadvantages of each, including effects on service life, economy of operations, ease of maintenance, desired appearance, necessary standardized features, reliability, traffic flow during construction, safety, and contract time.
 - c. Complete plans, specifications, and calculations showing proposed revisions relative to the original contract features and requirements. All plans and Engineering calculations shall bear the signature and seal of a professional Engineer licensed to practice in the State of Louisiana.
 - d. Detailed estimates of the cost to the City for performing the work under the existing contract and under the VE Proposal, including a listing of contract items affected by the proposal, and quantity variations attributable thereto with the related costs.
 - e. An assessment of any effects that adoption of the VE Proposal could have on other costs to the City, including future maintenance and operation.
 - f. A statement of the latest time or date that any agreement adopting the VE Proposal must be executed in order to obtain the maximum cost reduction during the

remainder of the contract and the reasoning for this time schedule. This date must allow the City time for review and processing of a plan change. Should the City find insufficient time is available for review and processing, it may reject the VE Proposal on such basis. If the City fails to respond to the VE Proposal by the date or time specified, the Contractor shall consider the proposal rejected and shall have no claim against the City.

- g. A statement of the effect that adoption of the VE Proposal will have on the time for completion of the contract.
- h. A description of any previous use or testing of the final VE Proposal on another City project or elsewhere and the conditions and results therewith. If the final VE Proposal was previously submitted on another City project, indicate the date, the project, and the action taken by the City.

The provisions of this Subsection shall not be construed to require the City to consider any VE Proposal which may be submitted. The City reserves the right to reject any and all VE Proposals. The bidders are cautioned not to base any bid prices on the anticipated approval of a VE Proposal and to recognize that the proposal may be rejected. In the event of rejection, the Contractor will be required to complete the contract at the contract bid prices. Proposed changes in basic configuration and design of a bridge, hydraulic capacity of drainage facilities, type or minimum thickness of pavements, or changes in grade or alignment which do not meet the geometric standards of the project as conceived, will not be considered as acceptable VE Proposals. If the City is already considering certain revisions to the contract or has approved certain changes in the contract for general use which are subsequently incorporated in a VE Proposal, the City will reject the Contractor's proposal and may proceed without obligation to the Contractor.

The City will not be liable to the Contractor for failure to act upon or accept any VE Proposal nor for any delays to the work attributable to any such proposal. The Contractor may withdraw, in whole or in part, any VE Proposal not accepted by the City within the period specified in the proposal. The decision of the City as to the acceptance or rejection of VE Proposals shall be final and shall not be subject to claim for additional compensation.

The Contractor will be notified in writing of the City's decision to accept or reject each VE Proposal submitted under these provisions. If a VE Proposal is accepted, the necessary contract modifications will be implemented by execution of a plan change, which will provide for equitable price adjustments giving the Contractor and the City equal shares in the resulting net savings. Until a VE Proposal is effected by such contract modification, the Contractor shall perform the work in accordance with the terms of the existing contract. The net cost savings to be shared shall be determined as the difference in costs between the original contract costs for the involved work items and the actual final costs to the City occurring as a result of the proposed change. Only those work items directly affected by the plan change will be considered in making the final determination of net cost savings.

Subsequent plan changes affecting the modified work items but not related to the VE Proposal, will be excluded from such determination. In reviewing the VE Proposal, the City reserves the right to reject the proposal if, in its judgment, the proposed net cost savings do not represent a reasonable measure of the value of the work to be performed or deleted. All costs incurred by the Contractor in developing the VE Proposal shall be borne by the Contractor. The plan change implementing the necessary contract modifications shall include a pay item for and a lump sum estimate of the approximate net cost savings anticipated as a result of the VE Proposal, and a proportionate amount thereof shall be included in partial payment estimates as the work on the modified contract items is performed. The Contractor's 50 percent share of the net cost savings shall constitute full compensation for implementing all changes pursuant to the agreement. Any time savings for early completion of the project resulting from the VE Proposal will be considered upon completion of the project as an incentive to the Contractor provided the contract contains an incentive clause for early completion of the work and the Contractor has not

met the incentive limit in the contract.

The City reserves the right to include in the agreement any conditions it deems appropriate for consideration, approval, and implementation of the VE Proposal. The City also reserves the right to require the Contractor to share in the City's costs of investigating a VE Proposal submitted by the Contractor as a condition of considering such proposal. The City will have the option to perform the investigation in-house or by consultants. When such a condition is imposed, the Contractor shall indicate his acceptance in writing, and such acceptance shall constitute full authority for the City to deduct amounts payable to the City from any monies due or that may become due to the Contractor under the contract.

The City reserves the right to adopt a VE Proposal for general use when it determines that said proposal is suitable for application to other contracts. When an accepted VE Proposal is adopted for general use, only the Contractor who first submitted such proposal will be eligible for compensation pursuant to this Subsection, and in that case, only as to those contracts awarded to him prior to submission of the accepted proposal. VE Proposals identical or similar to previously submitted proposals will be eligible for consideration and compensation under these provisions if the identical or similar previously submitted proposals were not adopted for general application to other City contracts. Subject to the provisions contained herein, the State or any other public agency shall have the right to use all or any part of any submitted VE Proposal without obligation or compensation of any kind to the Contractor.

Any changed conditions arising as a result of the acceptance of a VE Proposal will not be considered as the basis for any claim for additional compensation

SECTION 106

CONTROL OF MATERIALS

106.1 SOURCE OF SUPPLY AND QUALITY. The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of the proposed sources of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources or make necessary changes to provide acceptable materials.

106.2 FURNISHING OF MATERIALS. The Contractor shall furnish all materials required to complete the work, except those specified to be furnished by the City.

Material furnished by the City will be delivered or made available to the Contractor at the points specified in the Special Provisions.

The cost of handling and placing all materials after they are delivered to the Contractor shall be considered as included in the contract price for the item in connection with which they are used.

The Contractor will be held responsible for all material delivered to the Contractor, and deductions will be made from any monies due the Contractor to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur after such delivery and for any demurrage charges.

106.3 SUBSTITUTES AND “OR-EQUALS”.

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a certain brand, make, or manufacturer, or by using a definite specification, these are used only to describe the general style, type, character, and quality of the product desired. The Contractor is not restricted to the specific brand, make, manufacturer, or specification named, and equivalent products may be acceptable. Unless the specification or description contains or is followed by words reading that no like, equivalent, or “or-equal” item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

106.3.1 “Or-Equal” Items. If in the sole discretion of Engineer an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an “or-equal” item, in which case review and approval of the proposed item may be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Subsection, a proposed item of material or equipment will be considered functionally equal to an item so named if:

- A. in the exercise of reasonable judgment Engineer determines that:
 - 1. it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2. it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3. it is equal in spare parts availability, ease of maintenance, and other considerations;

- B. Contractor certifies that, if approved and incorporated into the Work:
1. there will be no increase in cost to the City or increase in Contract Time; and
 2. it will conform substantially to the detailed requirements of the item named in the Contract Documents.
 3. it has a proven record of performance and availability of responsive service.

106.3.2 Substitute Items. If in the sole discretion of Engineer an item of material or equipment proposed by Contractor does not qualify as an “or-equal” item under Subsection 106.3.1, it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor. The requirements for review by Engineer will be as set forth in Subsection 106.3.1 as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1. shall certify that the proposed substitute item will:
 - a. perform adequately the functions and achieve the results called for by the general design,
 - b. be similar in substance to that specified, and
 - c. be suited to the same use as that specified;
2. will state:
 - a. the extent, if any, to which the use of the proposed substitute item will prejudice Contractor’s achievement of Final Completion on time,
 - b. whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with City for other work on the Project) to adapt the design to the proposed substitute item, and
 - c. whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
3. will identify:
 - a. all variations of the proposed substitute item from that specified, and
 - b. available engineering, sales, maintenance, repair, and replacement services; and
4. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

106.3.3 Substitute Construction Methods or Procedures. If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of

construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Subsection 106.3.2.

106.3.4 Engineer's Evaluation. Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Subsections 106.3.2 and 106.3.3. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

106.3.5 Special Guarantee. City may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

106.3.6 Engineer's Cost Reimbursement. Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Subsections 106.3.1 and 106.3.2. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse City for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse City for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with City) resulting from the acceptance of each proposed substitute.

106.3.7 Contractor's Expense. Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

106.4 MATERIALS AND WORKMANSHIP. All materials, parts and equipment furnished by the Contractor shall be new, high grade, and free from defects and imperfections unless otherwise hereinafter specified or written approval is given under Article 106.5. Workmanship shall be in accord with the best standard practices. Both materials and workmanship shall be subject to the approval of the Engineer.

All materials and workmanship not conforming to the requirements of these specifications shall be considered as defective and will be rejected. Defective material whether in place or not, shall be removed immediately from the site of the work by the Contractor at the Contractor's expense when so directed by the Engineer. No rejected material, the defects of which have been subsequently corrected, shall be used until approval in writing has been given by the Engineer.

In the event any defect in material or workmanship is of a minor nature and the Engineer determines that it is not of such consequence as to result in a dangerous or undesirable condition, or that the removal of such work would create a dangerous or undesirable condition, the Engineer shall have the right to retain such work and make such deductions in the payment therefore as they determine reasonable and in the public interest. Such determination by the Engineer shall be final.

106.5 USE OF MATERIALS FOUND ON THE WORK. The Contractor, with written approval of the Engineer, may use on the project such stone, gravel, sand, topsoil or other material determined acceptable by the Engineer as may be found in the excavation and will be paid both for the excavation of such materials at the corresponding contract unit price and for the pay item for which the excavated material is used. The Contractor shall replace at the Contractor's own expense, with acceptable material, all of that portion of the removed material which was needed for embankments, backfill, approaches or otherwise. No charge for the materials so used will be made against the Contractor. The Contractor shall neither excavate nor remove any material from within the highway location which is not within the grading limits, as indicated by the slope and grade lines, without written authorization from the Engineer. If authorization is obtained, payment will not be made for excavation beyond the minimum slope and grade lines.

Materials from existing structures may be used temporarily by the Contractor in the erection of new structures. Modification of such material will not be permitted except with the approval of the Engineer.

106.6 TESTS OF MATERIALS. Except as may otherwise be provided in specific instances, all testing that may be required by the City to determine the quality, fitness and suitability of such materials shall be performed at the direction and upon the order of the Engineer, and at no expense to the Contractor, except as provided in Subsection 106.3. Where tests prove that such materials do not meet the specified requirements, and retests are required for this reason, the cost for such retests shall be borne by the Contractor. Samples of materials may be secured and tested whenever considered necessary by the Engineer. In certain cases where the Contractor is required to provide and bear the expense of such testing, the specifications or drawings will be definitely so stated.

The Contractor, at the Contractor's own expense, shall deliver the materials for testing at the time and to the place designated by the Engineer.

106.7 INSPECTION AT SOURCE. If the volume of work, construction progress, and other considerations warrant, the Engineer may undertake the inspection of material or plant equipment at the source, but it is understood that no obligation is assumed to inspect materials in this manner. Such inspection will be undertaken solely as a matter of convenience to the Contractor and producers. Further, the following conditions must be met:

1. The cooperation and assistance of the Contractor and the producer with whom the Contractor has contracted for materials or plant equipment is assured;
2. The representative of the Engineer shall have free entry at all times to such parts of the plant as may concern the manufacture or production of the materials or equipment ordered;
3. The cost of tests or inspections made at plants or sources located outside the territorial limits of Caddo Parish shall be borne by the Contractor or producer.

106.8 LIST OF MATERIALS AND EQUIPMENT. If required by the Engineer, within thirty days after signing the contract, the Contractor shall submit to the Engineer a list of all materials and equipment ordered for the project, the manufacturers or agents from whom ordered, catalog and type number, quantity ordered and promised delivery date on each item. Any subsequent changes in the list of equipment and materials, manufacturer's type, quantity or delivery dates shall be promptly brought to the attention of the Engineer. Shipping notices shall be furnished to the Engineer in adequate time prior to delivery so that provisions for inspection on receipt can be made.

106.9 STORAGE OF MATERIALS. All materials shall be stored and protected as specified in Technical Specification Section 4600 Delivery, Storage, and Handling. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the Work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the Site may be used for storage purposes and for the placing of the Contractor's plant and equipment, but any additional space required therefore must be provided by the Contractor at no additional cost to the City. Private property shall not be used for storage purposes without written permission of the owner and lessee., copies of such written permission shall be furnished. All storage sites shall be restored to their original condition or to the satisfaction of the property owner or lessee by the Contractor at no additional cost to the City. This shall not apply to the stripping and storing of topsoil or to other material salvaged from the work.

106.10 HANDLING MATERIALS. All materials shall be transported and handled as specified in Technical Specification Section 4600 Delivery, Storage, and Handling. All materials shall be handled in such a manner as to preserve their quality and fitness for the work. Aggregate materials shall be transported from the storage site to the work site in tight vehicles so constructed as to prevent loss or segregation of

materials after loading and measuring in order that there be no inconsistencies in the quantities of materials intended for incorporation in the Work as loaded and the quantities as actually received at the place of operations.

106.11 UNACCEPTABLE MATERIALS. All materials not conforming to the requirements of the specifications shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work unless otherwise instructed by the Engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

SECTION 107

GOVERNMENTAL REGULATIONS

107.1 GENERAL. It is the Contractor's responsibility to be fully apprised of all Federal, State and local laws, ordinances and regulations, and all orders and decrees of bodies of tribunals having any jurisdiction or authority, which affect those engaged or employed on the work or which affect the conduct of the work. The Contractor shall at all times observe and comply with all such laws, bylaws, ordinances, codes, regulations, orders and decrees. The Contractor shall indemnify the state and its representatives against any claim or liability arising from the violation of any such law, bylaw, ordinance code, regulation, order or decree, whether by the Contractor or the Contractor's employees.

107.1.1 Plant Quarantine Regulations. Soil and any soil-moving equipment operating in regulated areas will be subject to plant quarantine regulations. In general, these regulations provide for the cleaning of soil from equipment before it is moved from regulated areas to prevent the spread of harmful agricultural pests from areas quarantined by the State or U.S. Department of Agriculture. Complete information may be secured by contacting the appropriate district office of the USDA Plant Protection Division.

107.2 LAWS AND REGULATIONS. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, Engineer shall not be responsible for monitoring Contractor's compliance with any Laws or Regulations.

If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of their obligations regarding reporting and resolving discrepancies.

Changes in Laws or Regulations not known at the time of opening of Bids having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Time. If City and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Section 105, CHANGES IN WORK.

SECTION 108

CONTRACTOR'S RESPONSIBILITIES

108.1 PROJECT SITE MAINTENANCE.

108.1.1 Cleanup and Dust Control. Throughout all phases of construction, including suspension of work, and until final acceptance of the Project, the Contractor shall keep the work Site clean and free from rubbish and debris, and shall abate dust nuisance. Care shall be taken to prevent spillage on haul routes, any such spillage shall be removed immediately and the area cleaned. Removal and disposal of waste material, rubbish, spillage, and other debris shall conform to applicable laws and regulations and shall be incidental to the Work. Failure to comply with the Engineer's instructions for cleanup orders may result in temporary suspension of work until the condition is corrected. No additional compensation will be authorized as a result of such suspension. Perform cleanup and dust control as specified in Technical Specification Section 4562 Dust Control and Technical Specification Section 4710 Cleaning.

108.1.2 Air Pollution Control. The Contractor shall not discharge smoke, dust, or any other air contaminants into the atmosphere in such quantity that will violate the regulations of any legally constituted authority.

108.2 TEMPORARY FACILITIES.

108.2.1 Temporary Light, Power, and Water. The Contractor shall at its own expense furnish, install, maintain, and remove all temporary light, power, and water, including piping, wiring, lamps, and other equipment, necessary for the work. The Contractor shall not draw water from any fire hydrant, except to extinguish a fire, without first obtaining permission from the water agency concerned.

108.2.2 Sanitation. The Contractor shall provide and maintain enclosed toilets for the use of employees engaged in the work. These accommodations shall be maintained in a neat and sanitary condition. They shall also comply with all applicable laws, ordinances, and regulations pertaining to the public health and sanitation of dwellings and camps.

Sewage flows shall not be interrupted. Should the Contractor disrupt existing sewer facilities, sewage shall be conveyed in closed conduits and disposed of in a sanitary sewer system. Sewage shall not be permitted to flow in trenches or be covered by backfill.

108.2.3 Field Office. When required by the Engineer or the Special Provisions, the Contractor shall provide and maintain field office(s) as specified in Technical Specification Section 4500, Temporary Facilities.

108.3 PUBLIC CONVENIENCE AND SAFETY

108.3.1 Traffic and Access. The Contractor shall be familiar with the Shreveport Ordinances concerning Traffic Barricades and the current MUTCD.

The Contractor's operations shall cause no unnecessary inconvenience. The access rights of the public shall be considered at all times. Unless otherwise authorized, traffic shall be permitted to pass through the work, or an approved detour shall be provided.

The Contractor shall provide and maintain safe and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, hospitals, and establishments of a similar nature. Access to these facilities shall be continuous and unobstructed unless otherwise approved by the Engineer. The Contractor shall also maintain safe and adequate pedestrian zones and public transportation stops, as well as pedestrian

crossings of the work at intervals not exceeding 300 feet, unless otherwise approved by the Engineer.

The Contractor shall maintain vehicular access to residential driveways to the property line, except when necessary construction precludes such access for reasonable periods of time. If backfill has been completed to such extent that safe access may be provided and the street is opened to local traffic, the Contractor shall immediately clear the street and driveways and provide and maintain access at no additional pay.

The Contractor shall cooperate with the various parties involved in the delivery of mail and the collection and removal of trash and garbage to maintain existing schedules for these services.

Grading operations, roadway excavation and fill construction shall be conducted by the Contractor in a manner to provide a reasonably satisfactory surface for traffic. When rough grading is completed, the roadbed surface shall be brought to a smooth, even condition that is satisfactory for traffic.

Unless otherwise authorized, work shall be performed in only one-half of the roadway at one time. One-half shall be kept open and unobstructed until the opposite side is ready for use. If only one-half of a street is being improved, the other half shall be conditioned and maintained as a detour.

The Contractor shall include in his bid all costs for the above requirements.

108.3.2 Storage of Equipment and Materials in Public Streets. Construction materials may not be stored in streets, roads, or highways for more than 5 days after unloading. All materials or equipment not installed or used in the construction within 5 days after unloading shall be stored elsewhere by the Contractor at its expense unless the Contractor is authorized additional storage time.

Construction equipment shall neither be stored at the work site before its actual use on the work, nor for more than 5 days after it is no longer needed on the work. Time necessary for repair or assembly of equipment may be authorized by the Engineer. Excavated material, except that which is to be used as backfill in the adjacent trench, may not be stored in public streets, roads, or highways unless otherwise permitted. After placing backfill, all excess material shall be removed immediately from the site.

108.3.3 Street Closures, Detours, Barricades. The contractor shall be familiar with the MUTCD. Work of this project shall be in accordance with all applicable city ordinances. The Contractor shall comply with all applicable State, Parish and City requirements for closure of streets. The Contractor shall provide barriers, guards, lights, signs, temporary bridges, flagpersons and watchpersons, advising the public of detours and construction hazards. The Contractor shall also be responsible for compliance with additional public safety requirements which may arise during construction. The Contractor shall furnish and install, and upon completion of the work, promptly remove all signs and warning devices.

The Contractor shall notify at least 48 hours in advance of closing, or partially closing, or of reopening, any street, alley, or other public thoroughfare, the Police, Fire, Traffic and Engineering, Sportran, Caddo Parish School Board, and Departments of jurisdictional agencies involved and comply with their requirements. Deviations must first be approved in writing by the Engineer.

The Contractor will be held responsible for all damage to the work due to the failure of barricades, signs, lights and watchmen to protect it, and whenever evidence is found of any such damage, the Engineer may order the damaged portion immediately removed and replaced by the Contractor at his own expense. The Contractor's responsibility for the maintenance of barricades, signs, and lights and for providing watchmen shall not cease until the work of the contract has been completed and accepted.

108.3.4 Truck Bed Covers. Trucks or other conveyances hauling loose materials, including hot-mix bituminous materials, on public streets, highways, or detours shall be of an approved type, and if required by the Engineer, shall be covered in such manner as to prevent such materials from dropping, lifting, leaking, or otherwise escaping therefrom. Covering for trucks or other conveyances hauling loose

materials as herein provided shall be securely fastened so as to prevent said covering or load from becoming loose, detached, or in any manner a hazard to public traffic. No vehicle in violation of this provision will be permitted to operate. When required by the Engineer, truck bed covers of an approved type shall be used on all trucks hauling hot-mix bituminous materials to prevent heat loss or moisture infiltration.

108.3.5 Use of Explosives. Explosives may be used only when authorized in writing by the Engineer, or otherwise stated in the Special Provisions. Explosives shall be handled, used, and stored in accordance with all applicable regulations.

The Engineer's approval of the use of explosives shall not relieve the Contractor from liability for claims arising from blasting operations.

108.3.6 Loading Structures. Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

108.3.7 Emergencies. In emergencies affecting the safety or protection of the public or persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by the Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

108.4 PATENT FEES OR ROYALTIES. Contractor shall pay all license fees and royalties and assume all costs incidental to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of City, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by the City in the Contract Documents.

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless City and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

108.5 ADVERTISING. The names of contractors, subcontractors, architects, or engineers, with their addresses and the designation of their particular specialties, may be displayed on removable signs. The size and location of such signs shall be subject to the Engineer's approval. Commercial advertising matter shall not be attached to or painted on the surfaces of buildings, fences, canopies, or barricades.

108.6 USE OF LANDS.

108.6.1 General. For the performance of the contract, the Contractor will be permitted to occupy such portions of streets, alleys, or public places or other rights of way or servitude as provided by local ordinances, as shown on the plans, or as permitted. A reasonable amount of tools, materials, and equipment for construction purposes may be stored in such spaces that may be designated to be left free and unobstructed; the storage of such materials shall not inconvenience occupants of adjoining property. Other contractors performing work for the City may, for all purposes required by their contracts, enter

upon the work and premises used by the Contractor, and the Contractor shall give them all reasonable facilities and assistance for the completion of adjoining work. Any additional grounds desired by the Contractor for his use shall be provided by him at his own expense.

Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless City and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against City, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work

108.6.2 Work in State Highway Right-of-Ways. When the Work intersects or encroaches upon State Highway rights-of-way, Contractor shall obtain permission from Louisiana Department of Transportation and Development (LADOTD) with regard to methods of construction, materials, and safeguards. LDOTD may provide special details of construction and detailed specifications for Contractor's use in performance of the Work within State Highway rights-of-way.

108.6.3 Work in Servitude Over Private Property. Where the work passes over or through private property the City will provide such right-of-way by servitude agreements. The servitude agreements will provide for the temporary use of immediately adjacent property for construction purposes. The Contractor shall notify the owner of the adjacent property not less than 48 hours in advance of any work on said property and shall arrange for access and entry. Where fences must be removed either for construction purposes or for access, they shall immediately be reconstructed or replaced. The Contractor shall provide adequate gates as necessary to contain or restrict domestic farm animals within their proper areas during the life of this contract and shall provide reasonably safe and convenient means of access where and when required. The Contractor shall not injure or destroy trees or shrubs; furthermore, the Contractor shall not remove or cut them without the proper authority.

108.6.4 Preservation and Restoration of Property. The Contractor shall protect all public and private property insofar as it may be endangered by his operations and he shall take every reasonable precaution to avoid damage to such property.

Public or private improvements or facilities within the right-of-way not designated for removal, but visibly evident or correctly shown on the plans, which are damaged or injured, directly or indirectly, by or on account of any act, omission, or neglect of the Contractor in the execution of the work, shall be restored by the Contractor at its expense to a condition substantially equivalent to that existing before such damage or injury occurred, by repairing, rebuilding, or otherwise affecting restoration thereof. However, if restoration is not feasible, a reasonable settlement shall be reached with the owner of the damaged property.

The Contractor shall not trespass on public or private property without permission to do so and shall at all times take proper precautions to protect public and private property from damage.

The Contractor shall restore at his own expense any public, city-owned or private property damaged for

which he is directly or indirectly responsible to a condition equal to that existing before the damage. If he fails to do so, and/or refuses to do so upon notice, the City may cause such restoration and deduct costs from monies due, or which may become due, to the Contractor.

108.6.5 Availability of Lands. City shall furnish the Site. City shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. City will obtain in a timely manner and pay for servitudes for permanent structures or permanent changes in existing facilities. Upon reasonable written request, City shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and City's interest therein as necessary for giving notice of or filing a construction lien against such lands in accordance with applicable Laws and Regulations. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

108.7 RAILWAY-HIGHWAY PROVISIONS. All work to be performed by the Contractor in construction on a railway right-of-way shall be in accordance with the following provisions:

1. The Contractor shall notify the Railway's duly designated representative at least 10 days in advance of the date on which the Contractor is expected to begin work on the Railway's premises.
2. During the progress of work on or about the Railway's tracks or premises, the Contractor shall maintain contact and liaison with the Railway's officers or representatives for purposes of ascertaining the time of passage of trains at the work in order to clear the Railway's tracks and facilities of people, equipment and obstructions in order to allow free flow of railway traffic. The Contractor shall perform work on the Railway's premises without materially interfering with the Railway's tracks, structures and facilities or operations, or the operations of the Railway's tenants or licensees. Also, the Contractor shall not materially interfere with communication and signal lines upon said premises, except under arrangement effected between the Contractor and the Railway. The Contractor shall protect the Railway's property and avoid accidents. The Contractor shall keep the Railway's track and roadbed free of earth, rock, construction materials, debris and obstructions. The Contractor shall immobilize equipment parked near the Railway's track, when such equipment is unattended, to prevent its movement by unauthorized persons.
3. The Contractor shall, before entering upon the Railway's right-of-way for performance of any construction work, or work preparatory thereto, secure permission from the Railway's representative for the occupancy and use of the Railway's right-of-way outside the limits of the highway servitude area and shall confer with the Railway relative to requirements for railway clearances, operation and general safety regulations.
4. The Railway's representative will at all times have jurisdiction over the safety of railway operations. The decision of the Railway's representative as to procedures which may affect the safety of railway operations shall be final. The Contractor shall be governed by such decision.
5. Should any damage occur to railway property, as a result of the Contractor's unauthorized or negligent operations, and the Railway deems it necessary to repair such damage or perform work for the protection of its property, the required materials, labor and equipment shall be furnished by the Railway. The Contractor shall reimburse the Railway for any costs incurred.
6. If the Contractor requires access across the Railway's right-of-way and tracks at any location which is not an existing permanent type of open public railway-highway crossing

in or incident to the construction of the project, the Contractor shall contact the Railway and request access across said right-of-way and tracks and execute a license agreement with the Railway. The Contractor shall reimburse the Railway for the cost of providing and removing any temporary at-grade and grade-separated structure access crossing, including warning devices, watchmen expense or other costs which the Railway deems necessary for protection of Railway property and operations. The type of temporary crossing required shall be determined by the Railway. The Contractor shall not cross the Railway's right-of-way and tracks with vehicles or equipment except at existing open public road crossings or at such crossings established pursuant to this paragraph. The foregoing requirements include new grade crossings which will become part of the finished highway being constructed under the contract. The Contractor shall comply with the requirements for insurance contained under Heading (n) hereinafter during operations hereunder. The Contractor shall cooperate with the Railway during all phases of the work including providing sufficient advance notice for project completion in order for the Railway to remove the temporary grade crossing and perform final grade crossing improvements under the agreement with the City prior to final acceptance.

7. Any engineering, inspection, training, flagging and watcher service required by the Railway for the safety of Railway operations because of work being performed by the Contractor or in connection therewith, shall be provided by the Railway and the cost thereof shall be reimbursed to the Railway, by the Contractor, on the basis of the Railway's bills, to be rendered monthly. The Contractor will be reimbursed, by the City, for the actual incurred cost for such services. The Contractor shall furnish documentation of railway invoices and evidence of payment before reimbursement. When it is determined that railroad services and/or crossings are no longer in the best interest of the City, the Contractor will be issued written notification that no further reimbursement will be made by the City for railroad services. Work done or services provided for the Contractor's convenience will not be reimbursed by the City. The Contractor shall notify the Railway 72 hours in advance of when railway services are required.
8. The Contractor will be required to reimburse the Railway monthly for the cost of all services performed by the Railway for the Contractor, and furnish the City satisfactory evidence that the Railway has acknowledged receipt of payment before final acceptance.
9. During construction of piers or other supports or structures adjacent to any track, or of drainage pipe or structure under or adjacent to any track of the Railway, the Contractor shall make adequate provisions against sliding, shifting, sinking or in any way disturbing the railway embankment and track adjacent to said piers, supports or structures due to construction operations by driving temporary sheeting or by other means satisfactory to the City and Railway.
10. Before commencing work on any pier or structure adjacent to any track, or on any structure and parts thereof which carry Railway facilities, the Contractor shall submit to the Engineer for approval, prints of the proposed sheeting, shoring, bracing and false work details for protection of the Railway's track and embankment and shall submit prints of the shop drawings or other Contractor's detailed plans for structures and parts thereof which will carry Railway facilities. This submittal shall include proposed methods of construction and be accompanied by supporting data, including design computations, soil descriptions and other pertinent information. After approval by the Engineer, four prints of the above plans, shop drawings and details bearing the seal of a registered Civil Engineer, with supporting data and documents, shall be forwarded to the Railway for approval. Prior to beginning work on a Railway right-of-way, the shop drawings and details, with supporting data and documents, shall be approved by the Railway.

11. The Contractor shall notify the Railway's representative in writing at least one week in advance of the proposed time of the beginning of construction of piers, supports or structures adjacent to the track or of drainage pipe or structure under or adjacent to the track.
12. The following temporary clearances are the minimum which shall be maintained during construction operations: Vertical: 22.5 feet (6.86 meters) above top of highest rail; Horizontal: 10.0 feet (3.05 meters) from centerline of the nearest track measured at right angles thereto. If lesser clearances are required for any part of the work, the Contractor shall secure written authorization from the Railway's representative for such lesser clearances in advance of the start of work on that portion of the project along, on, over, under or across the right-of-way or tracks of the Railway.
13. The Contractor shall not store or construct false work or store materials, supplies or equipment closer than 15.0 feet (4.57 meters) from the centerline of any railway track, measured at right angles thereto, or 22.5 feet (6.86 meters) vertically from top of the rail.
14. Unless otherwise specified by special provisions, the Contractor shall provide insurance of the following kinds and amounts:
 - a. Regular Contractor's Public Liability and Property Damage Insurance, including automobile, issued in the name of the Contractor shall be written to furnish protection to the Contractor respecting operations in performing work covered by the contract in regard to the liability with respect to bodily injury to or death of persons, and injury to or destruction of property, which may be suffered by persons other than the Contractor's employees as a result of operations in connection with construction of highway projects located wholly or partly within railroad right-of-way.
 - b. When a Contractor sublets a part of the work on any project to a subcontractor, the Contractor shall be required to secure insurance protection in the Contractor's own behalf under Contractor's Public Liability and Property Damage Insurance policies to cover any liability imposed on the Contractor by law for damages due to bodily injury to or death of persons and injury to or destruction of property as a result of work undertaken by such subcontractors. In addition, the Contractor shall provide for, and on behalf of, any such subcontractors protection to cover like liability imposed upon the latter as a result of their operations by means of separate and individual Contractor's Public Liability and Property Damage policies. As an alternative, each subcontractor shall provide satisfactory insurance as described herein on the subcontractor's own behalf to cover the sub Contractor's individual operations.
 - c. Railroad Protective Liability Insurance shall be purchased on behalf of the Railway by the Contractor. The standards for Railroad Protective Liability Insurance shall be in accordance with provisions of the Federal-Aid Policy Guide (FAPG) Part 646 as amended. The limits of liability for the kinds of insurance required above shall be as follows:

NORMAL COVERAGE (other than AMTRAK)

(1), (2) and (3)

Combined Single Limit for Bodily Injury Liability, Property Damage
Liability and Physical Damage to:

Property - \$2,000,000 per occurrence

Aggregate Limit - \$6,000,000 for the term of the policy

AMTRAK COVERAGE

(1), (2) and (3)

Combined Single Limit for Bodily Injury Liability, Property Damage
Liability and Physical Damage to:

Property - \$5,000,000 per occurrence

Aggregate Limit - \$12,000,000 for the term of the policy

The name of the Railway and the ratio of the estimated cost of operations within the Railway's property to the total estimated project cost, expressed by percent, will be specified in the project specifications. No direct payment will be made for providing the required insurance coverages by the Contractor. The Contractor shall furnish to the Railway the Railroad Protective Policy and certificates evidencing the other insurance coverage required above. The Railroad Protective Insurance Policy and all insurance certificates shall be approved by the Railway before any work may be started on the Railway's property by the Contractor or subcontractors. In addition, the Contractor shall furnish evidence of commitment by the insurance company to notify the Railway and the Engineer in writing of any material change, expiration or cancellation of the policy not less than 30 calendar days before such change, expiration or cancellation is effective. The insurance specified shall be kept in force until final acceptance of the contract.

15. The Contractor shall indemnify the Railway, its officers and employees from all suits, actions or claims brought because of injuries or damages sustained by any person or property due to operations of the Contractor; due to negligence in safeguarding the work; or use of unacceptable materials in constructing the work; or any negligent act, omission or misconduct of the Contractor; or claims or amounts recovered from infringements of patent, trademark or copyright.

16. Upon completion of the work, the Contractor shall, within 10 calendar days, remove from within the limits of the Railway's right-of-way all machinery, equipment, surplus materials, false work, rubbish or temporary buildings of said Contractor, and restore the Railway's premises substantially to their former condition satisfactory to the Railway's representative. Should the Contractor fail to make such removal and restoration within 10 calendar days, the Railway shall have the right to make such removal or restoration. The expense incurred shall be chargeable to the project on the Railway's force account statement and the City will reimburse the Railway for such work. The amount will be deducted from payments due the Contractor.

17. All costs incurred under this subsection shall be included in the contract prices of other pay items. Prior to final acceptance of the project, the Contractor shall secure a Certificate of Release from the railroad company and furnish same to the City stating that the Contractor has satisfactorily restored the Railway's premises and has completed payments for all railway services performed for the Contractor's account, and that the Railway waives all claims for damages due to the Contractor's operations within railway right-of-way under the contract. If the Contractor is unable to secure a Certificate of Release from the Railway, the Contractor shall submit an executed Contractor's Affidavit, to the Engineer.

108.8 RESPONSIBILITY FOR DAMAGE CLAIMS.

108.8.1 General. The Contractor and his surety shall indemnify and save harmless the City and all its officers, agents and employees from all suits, actions, or claims of any character, name and description brought for or on account of any injuries or damages received or sustained by any person, persons, or property, by or from the said Contractor or his employees or by or in consequence of any neglect in safeguarding the work, or through the use of unacceptable materials in constructing the work or by or on account of any act or omission, neglect, or misconduct of the said Contractor or by or on account of any claims or amounts recovered by any infringement of patent, trademark, or copyrights or from any claims or amounts arising or recovered under the workmen's Compensation Law or any other law, ordinance,

order or decree, and so much of the money due the said Contractor under and by virtue of his contract, as shall be considered necessary by the City, may be retained or in case no money is due, his surety shall be considered liable until such suit or suits, action or actions, claim or claims, for injuries or damages as aforesaid shall have been settled and satisfactory evidence to that effect furnished to the City, and the Contractor shall defend any and all suits arising out of any such claim and pay all costs and expenses in connection therewith including reasonable attorney fees.

108.8.2 Contractor's Responsibility. Until final written acceptance of the project by the Engineer, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements, or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to Acts of God, of the public enemy or of governmental authorities.

108.8.3 Personal Liability of Public Officials. In carrying out the provisions contained herein or in exercising any power or authority granted to him by this Contract, there shall be no personal liability upon the Engineer, or his authorized assistants or representatives or any official acting for the City, it being understood that in such matters they act as the agents of the City.

108.8.4 No Waiver of Legal Rights. Inspection by the Engineer or by any of his duly authorized representative, any order, measurement, or certificate by the Engineer; any order by the City for the payment of money any payment for or acceptance of any work or any extension of time; or any possession taken by the City, shall not operate as a waiver of any provision of the contract; or any power therein reserved to the City or of any right of damages therein provided. Any waiver of any breach of the contract shall not be held to be a waiver of any other or subsequent breach.

The City reserves the right to correct any error that may be discovered in any estimate that may have been paid, and to adjust the same to meet the requirements of the contract and specifications. The City reserves the right to claim and recover, by process of law, sums as may be sufficient to correct any error or make good any deficit in the work resulting from such error, dishonesty, or collusion upon conclusive proof of collusion or dishonesty between the Contractor or his agents and the Engineer or his assistants discovered in the work after final payment has been made.

108.8.5 Indemnification. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend, and hold harmless the City, its agents, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

In any and all claims against City, or any of its officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

The indemnification obligations of Contractor under Subsection 108.8.5 shall not extend to the liability of City or any of its officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

108.9 FINAL CLEANING UP. Before final acceptance, the Site, borrow and local material sources and all areas occupied by the Contractor in connection with the Work shall be cleaned of all rubbish, excess materials, temporary structural, haul roads and equipment; and all parts of the Work, including private property adjacent to the Site, which have been damaged or rendered unsightly during the Work shall be left in a neat and presentable condition acceptable to the Engineer, and if required, the Site shall be mowed; all at no additional cost to the City.

At the time of final acceptance, structures entirely constructed under the Project shall be free of rodents, insects, vermin and pests. Extermination work, if necessary, shall be arranged and paid for by the Contractor as part of the Work, and completed within the Contract Time. Extermination work shall be performed by a licensed agency in accordance with requirements of governing authorities. The Contractor shall be liable for injury to persons or property and responsible for the elimination of offensive odors resulting from extermination operations.

108.10 ARCHAEOLOGICAL AND HISTORICAL FINDINGS. If the Contractor encounters cultural artifacts or archaeological or historical sites, operations shall be discontinued. The Engineer will contact the proper authorities in order that an appropriate assessment may be made to determine the disposition thereof and necessary actions relative to the site. When directed, the Contractor shall excavate the site to preserve the artifacts encountered. Such excavation will be paid for as extra work, including an appropriate adjustment in contract time. Borrow and muck disposal areas furnished by the Contractor will be subject to such assessment prior to use.

108.11 OVERTIME. The Contractor shall be responsible for paying all construction inspectors' overtime for weekends and holidays worked. The Contractor will be billed at a rate of 1½ times the construction inspector's hourly rate for all weekend work and holiday work up to (eight) 8 hours plus 40% fringe benefits. All work over 8 hours on a holiday will be billed at 2½ times the hourly rate plus 40% fringe benefits.

The Contractor must sign a construction inspector's Overtime Compensation Authorization form prior to scheduling any weekend or holiday work. When the Contractor schedules weekend or holiday work, the Contractor will be charged a minimum of two hour show-up time for the inspector.

In addition to the Contractor's responsibility to pay all construction inspectors' overtime on weekends and holidays worked, any Contractor who begins work on a City project after 12:00 noon (12:00 p.m.) on a regular weekday and then continues to work after 5:00 p.m. on said regular weekday, may be charged overtime for all hours and half-hours after 5:00 p.m. in which the City furnished a construction inspector to said Contractor.

108.12 SAFETY PROGRAMS AND RESPONSIBILITIES.

108.12.1 Safety and Protection. Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;
2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

Contractor shall comply with the applicable requirements of City's safety programs, if any. Contractor shall inform Engineer of the specific requirements of Contractor's safety program with which City's and Engineer's employees and representatives must comply while at the Site.

All damage, injury, or loss to any property caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and City has issued a Final Completion notice to Contractor.

108.12.2 Safety Representative. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

108.12.3 Hazard Communication Programs. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations. Contractor shall provide copies of material safety data sheets to the City Risk Management office.

108.13 CONTRACTOR SIGN.

Provide and maintain Contractor Sign(s) as specified in Technical Specification Section 4580 Project Identification Signs.

108.14 NOT USED

108.15 PERMITS. Unless otherwise provided in the Special Provisions, Contractor shall obtain and pay for all construction permits and licenses. City shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Contract. City shall pay all charges of utility owners for connections for providing permanent service to the Work.

SECTION 109

UTILITIES

109.1 GENERAL. Utilities for the purpose of these specifications shall be considered as including, but not limited to: pipe lines, conduits, cables, transmission lines and appurtenances of Public Utilities and those of Special Utility Districts, businesses or individuals solely for their own use or for use of their tenants: and storm drains, sanitary sewers, street lighting, traffic signal and fire alarm systems, except those opened or under the direct control of the City.

When known, locations of surface and subsurface utilities and structures are shown on the plans for the convenience of the Contractor. The City does not guarantee that all such items are shown, nor does it assume responsibility for failure to show any structure or utility on the plans or to depict them in the exact location horizontally or vertically. Such failure shall not be cause for claims for extra compensation for extra work or for increasing the pay quantities. However, if an obstruction is encountered such as to necessitate changes in lines or grades, or requires the building of special works, not otherwise shown in the plans and proposal, then a case for extra work may exist and the Engineer may authorize it.

The City shall make available to the Contractor, upon request, all TV video records that it may have on existing sewer lines that are affected by the project. With regard to existing utility systems, the plan, profile and "As-built" drawings that the Engineer, local utilities, or other agencies of government or private firms may furnish are for the Contractor's general information to show approximate depths, sizes, locations and elevations. The accuracy of these documents, relative to the actual location and sizes of underground utilities, cannot be guaranteed, since it is a recognized fact that underground piping is known to deflect, to settle, to become disjointed or displaced, and to slightly shift or migrate from its originally installed position, etc., and maintenance crews may modify or alter utilities without revising the existing drawings. Consequently, the Contractor is responsible for conducting an independent examination to determine the actual dimensions, sizes, depths, etc., of existing in ground utilities.

Test pits, for the purpose of locating underground utilities or structures in advance of the construction, shall be excavated and backfilled by the Contractor. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Engineer. Test pits are considered incidental to the work and are at Contractor's option and expense. The Contractor's decision not to examine and determine the accuracy of drawings furnished by the City or by others is at the Contractor's sole risk. The contractor shall have no cause for additional compensation or time due to failure to verify the actual conditions and dimensions of underground facilities.

109.2 UTILITIES IN PUBLIC RIGHT-OF-WAY.

Unless otherwise provided or excepting as indicated in Section 109.4.6, the removal, adjusting, relocation, or replacement of utility structures or facilities within the public right-of-way which, in the opinion of the Engineer, may be necessary for construction of the Work, shall be performed by the respective owners of the utilities at their expense.

While it is the respective utility owner's responsibility to perform any work and bear any expense involved in relocations and adjustments called for on the plans or designated by the Engineer, it shall be the Contractor's responsibility to protect and maintain those utilities which, in the opinion of the Engineer, do not need to be disturbed in order to accomplish the Work required by the contract.

109.3 NOTIFICATION OF PUBLIC UTILITIES. Prior to the advertisement of the Project for bidding, the City and the known utility owners affected by the Work in public rights-of-way will exchange information which provides, on the part of the utility, the location of all known facilities within the right-of-way and the avoidance of these utilities by the design of the Work by the City, where feasible. The City will not be responsible for the accuracy of the locations so designated by the utility owner.

Service connections may or may not be shown.

When the Project is advertised for bidding, the Engineer will notify known owners of all utilities affected and provide them with plans of the improvements. This notification will generally allow sufficient time for the removal, adjustment, relocation or replacement of facilities prior to the commencement of construction. When, in the opinion of the Engineer, extensive work on the part of the utility owner necessitates more time than normal notification would allow, sufficient time, as determined by the Engineer, shall be given to perform the work, either through prior notification or through a delay in the commencement of the project work. Utility work which, in the opinion of the Engineer, may be done more feasibly in conjunction with the construction work, may be allowed, and the scheduling of such work shall be approved by the Engineer, and the cooperation of the Contractor is required.

In the event of conflict these specifications and Louisiana R.S., the Louisiana R.S. shall govern.

109.4 COOPERATION BETWEEN CONTRACTOR AND UTILITIES.

109.4.1 General. When the Work Order is received, the Contractor shall notify Louisiana One Call and the owners of utilities affected of the approximate date upon which he will begin work and shall submit a progress schedule of the proposed work. This shall be deemed sufficient notice if the project progresses according to the progress schedule submitted with the notification. If changes in the schedule of work occur, the Contractor shall apprise both the owner of the utility affected and the Engineer so that adjustments in the work schedule of the utility can be made. The Contractor shall be responsible for damages to the utility facilities and construction delays resulting from failure to notify the utility and the Engineer of changes in procedure or location. In order to avoid misunderstanding, the Contractor and the utility representatives on the job should establish a close working relationship.

109.4.2 Abandoned Utilities. Utilities, shown on the plans to be abandoned, which interfere with construction shall be removed by the Contractor and, if so designated, will be paid for as provided in Section 302. If no provision is made for payment, the removal shall be considered incidental and the cost of such removal shall be included in the price bid for other items. If noted on the plans or in the Special Provisions or if directed by the Engineer a utility owner may salvage his abandoned facilities. The arrangements for such salvage between the utility owner and the Contractor must be approved by the Engineer. The condition of the area of salvage must be no worse after the salvage operation than it was prior to the salvaging as determined by the Engineer. The Engineer shall require the utility owner to make repairs to the area of salvage if, in his opinion, the area is not in a good condition as it existed just prior to the salvage operation. In the salvage operation, the Contractor shall not be responsible for the work of the utility.

109.4.3 Utilities Not Within Working Limits. The protection and preservation of utility facilities which are located within the right of way, but outside the normal limits of construction, as determined by the Engineer, shall be the responsibility of the Contractor. The Contractor shall be responsible for all damage to utilities which are due to his negligence.

109.4.4 Utilities To Be Adjusted. The owners of utility facilities which require relocation, removal, adjustment or replacement shall, if possible and feasible, perform this work prior to the commencement of the Contractor's work. Where utility work must be done in conjunction with the Contractor's work on the project or in conjunction with the work of other utilities, arrangements for when, how, and where the operation is to proceed shall be worked out among the parties concerned. If disputes arise, the Engineer shall decide the course of action to be taken.

109.4.5 Utilities Conflicting With Operations. Those utility facilities which do not conflict with the improvement, but which are obstructions to the operations required for installation or which present unusual difficulty due to their close proximity to the area of the operation shall be located with certainty by the owners of the utility prior to the arrival of the Contractor's operation which would be hindered by the utility facility. The Contractor is required to preserve the utility facility in place without damage and

shall be responsible for damages sustained, if the utility owner has located the facility by exposing it to the view of the Contractor or has otherwise shown the Contractor, with certainty, the location of the facility. Any other arrangements that the Contractor may make with a utility owner as a substitute for the requirements of this section shall require the approval of the Engineer, in writing.

109.4.6 Utilities to be Relocated Under A Contract Item. Those facilities owned by Public Utilities which by reason of right of way or other agreements, rental to the City or other reasons, which require adjustment or relocation and are to be paid for under a contract item, shall save the work done on them by the utility owner or his Contractor. The work done on items to private utilities paid for under a contract item shall be performed by the Contractor.

The price bid for these items is set by the City and is based on preliminary estimates. The actual amount paid to the Contractor will be the amount of the invoice submitted by another contractor to the Contractor, or the amount of an invoice prepared by the Contractor, any of which must be substantiated by cost figures and which shall be approved by the Engineer.

109.4.7 Unknown Utilities. If, during the progress of the Contractor's work, underground utility structures or lines are found which were not indicated on the plans or if shown on the plans are in locations materially different from that shown, the City shall endeavor to discover the owner of the disclosed utility and have the owner perform any relocation or adjustment work necessary, however, if the owner cannot be immediately determined or if the Engineer decides that adjustment is necessary immediately, the Engineer may order the Contractor to perform the necessary work and pay him as prescribed in Section 105.

109.4.8 Mislocated Utilities. The owner of a utility shall be wholly responsible for the proper location of his facilities which are affected by construction work performed according to these specifications. Improperly located or mislocated facilities which are damaged during construction shall be the responsibility of the utility, providing notification according to Section 109.3 has been given.

109.5 WORK BY UTILITIES. All excavation and backfill work done by owners of utilities on projects for the City shall be performed to the same standard as required of the Contractor for the installation of similar items. Except for work performed by the utility owner under Section 109.4.2, it shall be the responsibility of the Contractor to inform the Engineer if the utility owner does not use a suitable backfill material or achieve an adequate compaction in his operation.

109.6 UNDERGROUND FACILITIES AT OTHER WORK SITES

The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to Sites other than public rights-of-way is based on information and data furnished to Engineer by the owners of such Underground Facilities, including City, or by others.

1. Engineer and City shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Amount, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including City, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work

If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith, identify the owner of such Underground Facility and give written notice to that owner and to Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Amount or Contract Time, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If City and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Amount or Contract Time, City or Contractor may make a Claim therefor as provided in Section 105, CHANGES IN WORK.

SECTION 110

PROSECUTION AND PROGRESS OF WORK

110.0 CONTROLLING ITEM OF WORK. The controlling item of work will be established by a Construction Progress Schedule. Progress Meetings will be scheduled as specified in Technical Specification Section 4300 Project Meetings. At these meetings, the Contractor will be given a statement of time changes and will be given ten (10) days to file a protest in an agreement cannot be reached at the meeting.

110.1 SUBLETTING OF CONTRACT. The Contractor shall not sublet, sell, transfer, assign or otherwise dispose of the contract or any portion thereof, or of his right, title or interest therein, without written consent of the Engineer. If such consent is given, the Contractor will be permitted to sublet a portion of the work but shall be required to pay at least Fifty-one percent (51%) of wages paid under the contract to workmen, mechanics or labors who are employed directly by the Contractor's own organization.

Any items designated in the contract as "Specialty Items" may be performed by subcontract, and the cost of any such Specialty Items so performed by subcontract may be deducted from the total cost before computing the amount of work required to be performed by the Contractor with his own organization. No subcontracts or transfer of contract shall serve to relieve the Contractor of his liability under the contract and bonds.

An approved Subcontractor shall not subcontract any portion of his authorized work.

Contractor shall not employ any Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, against whom City may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

If the Special Provisions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to City in advance for acceptance by City by a specified date prior to the Effective Date of the Contract, and if Contractor has submitted a list thereof, City's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by City of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Engineer to reject defective Work.

Contractor shall be fully responsible to City and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

- a. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between City or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
- b. shall create any obligation on the part of City or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of City and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on any property insurance required in the Special Provisions, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against City, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

110.2 NOTICE TO PROCEED. The "Notice to Proceed" will stipulate the date on which the Contractor shall begin the construction, which date shall be the beginning of the contract time charges.

110.3 CONSTRUCTION PROGRESS SCHEDULE Provide a Construction Progress Schedule in accordance with requirements of Technical Specification Section 4310 Construction Schedule.

110.4 PROSECUTION OF WORK.

110.4.1 General. The Contractor shall provide sufficient materials, equipment and labor to guarantee completion of the project in accordance with the plans and specifications within the contract time limit. If the completed work on any contract is behind the approved progress schedule, the Contractor shall take immediate steps to restore satisfactory progress.

Each item of construction shall be prosecuted to completion without delay and in no instance shall the Contractor transfer his equipment or forces from uncompleted construction without prior notice to, and approval of, the Engineer. If the prosecution of the work is discontinued for an extended period of time, the Contractor shall give the Engineer written notice at least 24 hours before resuming operations.

110.4.2 Disqualification. The Contractor's progress will be determined monthly at the time of each partial estimate, and will be based on the total amount earned by the Contractor as reflected by the partial estimate. If the Contractor's progress is more than 20% behind the elapsed contract time, he will be notified that he will be subject to disqualification if his progress becomes delinquent by more than the percentages specified hereinafter, and such additional notification will be made as the Engineer deems necessary concerning the progress delinquency of the Contractor.

Prior to the elapsing of 55% of the contract time, the Contractor will be disqualified if his progress on any contract is more than 40% behind the elapsed contract time. After 70% of the contract time has elapsed, the Contractor will be disqualified if his progress on any contract is more than 25% behind the elapsed contract time. Disqualification will be applied between 55% and 70% contract time elapsed on a pro-rata basis; for example, when 60% of the contract time has elapsed, the Contractor will be disqualified if his progress on any contract is more than 35% behind the elapsed contract time.

During the period of disqualification, the Contractor will not be permitted to bid on future contracts nor will he be approved as a subcontractor on future contracts. The period of disqualification will continue until the completed work on the contract is not delinquent by more than the foregoing percentages or until all work on the contract has been satisfactorily completed.

110.5 LIMITATION OF OPERATIONS. The Contractor shall conduct the work at all times in such manner and sequence as will assure the least interference with traffic. He shall have due regard to the location of detours and to the provisions for handling traffic. He shall not open up work to the prejudice or detriment of work already started, and the Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

110.6 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT. The Contractor shall at all times employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by these specifications.

110.6.1 Personnel. All workmen shall have sufficient skill and experience to perform properly the work assigned to them. Workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work satisfactorily.

Any person employed by the Contractor or by any subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or subcontractor employing such person and shall not again be employed in any portion of the work without the approval of the Engineer. Should the Contractor fail to remove such a person or fail to furnish suitable and sufficient personnel for proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

110.6.2 Methods and Equipment. All equipment proposed for use on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no damage to the roadway, adjacent property or other highways will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed in the contract, the Contractor is free to use any methods or equipment that will accomplish the contract work in conformity with the requirements of the contract.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than specified in the contract, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be responsible for producing construction work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality or take such other corrective action as the Engineer directs. No change will be made in basis of payment for the construction items involved or in contract time as a result of authorizing a change in methods or equipment under these provisions.

110.7 DETERMINATION AND EXTENSION OF CONTRACT TIME. The number of days or the dates stated in the Agreement to: achieve Milestones; if any; achieve Final Completion; and complete the Work so that it is ready for final payment excluding retainage will be known as the Contract Time. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of the applicable jurisdiction, such

day will be omitted from the computation.

110.7.1 Working Day Basis. When the contract time is on a working day basis, the Engineer will furnish the Contractor a monthly statement showing the number of days charged to the contract for the preceding month and the number of days specified for completion of the contract.

The Contractor will be allowed 10 days in which to file a written protest setting forth in what respect said monthly statement is incorrect, otherwise the statement shall be deemed to have been accepted by the Contractor as correct.

If a protest is filed by the Contractor, the City shall conduct such reviews and investigations as required to rule on the protest within 30 days from the date the statement is furnished the Contractor. The number of days charged as listed, or revised within the above allotted time, shall become final at the end of this 30-day period, subject to change only through legal action.

When the Contract Time is on a Working Day basis, time will be charged for each day the Contractor can perform Work on the Controlling Item of Work with his normal work force for 75 percent of the day or 6 hours in any 8-hour shift. The work force that is actively engaged in prosecuting the Controlling Item of Work will be considered as the "normal work force".

A calendar day, with the exceptions stated herein, on which weather and other conditions not under control of the Contractor will permit construction operations to proceed for at least 5 continuous hours of the day with the normal working force engaged in performing the Controlling Item of Work or items of Work which would be in progress at that time. No working days will be charged for the days listed below, except as specified in the subsequent paragraph.

- a. Saturdays and Sundays
- b. City-recognized holidays that are defined as regular legal holidays or special holidays that may be proclaimed by the Mayor or fixed by the City Council
- c. Days on which delays, attributable solely to the Department or other governmental agencies, prevent the Contractor from proceeding with the Controlling Item of Work in effect at the time of delay
- d. Days on which delays are attributable to the direct effect of strikes, riots, or civil commotions.

If the Contractor performs Work which requires Engineering layout, supervisions, or inspection on Saturday, Sunday, or a City-recognized holiday, a Working Day will be charged regardless of the size of the working force or the number of hours worked. Any work done in connection with the continuing of curing, loading of test piles, watering of sod, etc. as required by the specifications is excluded from the work defined in this subsection, and a Working Day will not be charged if that is the only work performed.

110.7.2 Calendar Day Basis. When the contract time is on a calendar day basis, it shall consist of the number of calendar days stated in the contract beginning with the effective date of the Engineer's order to commence work, including all Saturdays, Sundays, holidays and non-work days. All calendar days elapsing between the effective dates of any written orders by the Engineer to suspend work and to resume work for suspensions not the fault of the Contractor shall be excluded.

When the contract completion time is a fixed calendar date, it shall be the date on which all Work on the Project is complete. The number of days for performance allowed in the contract as awarded is based on the original quantities and includes the time necessary to procure material, equipment and an adequate labor force to complete the work properly. If satisfactory fulfillment of the contract requires performance of work in greater quantities than those set forth in the proposal, the contract time allowed for

performance shall be increased on a basis commensurate with the amount and difficulty of the added work.

If the Contractor finds it impossible, for reasons beyond his control, to complete the work within the contract time as specified or as extended in accordance with the provisions of this Subsection, he may, at any time prior to the expiration of the contract time as extended, make written request to the Engineer for an extension of time setting forth therein the reasons which he believes justify granting his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as conditions justify. The extended time for completion shall be in full force and effect as though it were the original time for completion. When final acceptance has been made by the Engineer as prescribed in Subsection 111.8.

110.8 LIQUIDATED DAMAGES. For each calendar day or work day, as specified, that any work shall remain uncompleted after the contract time specified for the completion of the work required by the contract, the sum specified below will be deducted from any money due the Contractor not as a penalty but as liquidated damages. Due account shall be taken of any adjustment of the contract time for completion of the work granted under the provisions of Subsection 110.7.

Permitting the Contractor to continue the work after expiration of the contract time or extended contract time will in no way operate as a waiver on the part of the City of any of its rights under the contract. The City may waive such portions of the liquidated damages as may accrue after the work is in condition for safe and convenient use by the traveling public.

Based on the amount of the original contract, the following charges per contract day will be made for each such day after expiration of the contract time or extended contract time. When the contract time is on either the calendar day or fixed calendar date basis, the schedule for calendar days shall be used. When the contract time is on a working day basis, the schedule for working days shall be used.

<u>ORIGINAL CONTRACT</u>		<u>DAILY CHARGE</u>	
<u>AMOUNT</u>			
From	To and	Calendar Day	
<u>More Than</u>	<u>Including</u>	<u>or Fixed Day</u>	<u>Working Day</u>
\$	\$	\$	\$
0	25,000	80.00	195.00
25,000	50,000	210.00	345.00
50,000	100,000	240.00	400.00
100,000	500,00	270.00	510.00
500,000	1,000,000	330.00	595.00
1,000,000	2,000,000	400.00	695.00
2,000,000		600.00	825.00

The amount of liquidated damages will be deducted from any money due the Contractor under this contract, and the Contractor and his surety shall be liable for any liquidated damages in excess of amounts due the Contractor.

110.9 TERMINATION FOR CAUSE. The occurrence of any one or more of the following events will justify termination for cause:

- a. Contractor's failure to begin the Work within the time specified in the Notice to Proceed;

- b. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Construction Progress Schedule;
- c. Contractor's unsuitable performance of the Work, neglect, refusal to remove materials, or refusal to correct any new Work rejected as unacceptable;
- d. Contractor's failure to complete the project within the Contract Time;
- e. Contractor's failure to resume Work which has been discontinued within a reasonable amount of time after receiving notice to do so;
- f. Contractor becomes insolvent, is declared bankrupt, or commits any act of bankruptcy or insolvency;
- g. Contractor allows any final judgment to stand against him unsatisfied for a period of 10 days;
- h. Contractor makes an assignment for the benefit of creditors;
- i. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
- j. Contractor's repeated disregard of the authority of Engineer; or
- k. Contractor's violation in any substantial way of any provisions of the Contract Documents.

If one or more of the events identified in the preceding paragraph occur, City may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

- a. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
- b. incorporate in the Work all materials and equipment stored at the Site or for which City has paid Contractor but which are stored elsewhere; and
- c. complete the Work as City may deem expedient.

If City proceeds with termination as described in the preceding paragraph, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by City arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to City. Such claims, costs, losses, and damages incurred by City will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, City shall not be required to obtain the lowest price for the Work performed.

Notwithstanding the preceding paragraphs, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

Where Contractor's services have been so terminated by City, the termination will not affect any rights or remedies of City against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by City will not release Contractor from liability.

If and to the extent that Contractor has provided a performance bond, the termination procedures of that bond shall supersede the provisions of this subsection.

110.10 TERMINATION OF CONTRACTOR'S RESPONSIBILITY. The contract will be considered complete when all work has been satisfactorily completed, the final inspection made and the work accepted by the chief Engineer. The Contractor will then be released from further obligation except as set forth in his contract bond, and except as provided in Subsection 108.9.2.

110.11 TERMINATION FOR CONVENIENCE. Upon seven days written notice to Contractor and Engineer, the City will terminate the Contract or portion thereof when the Contractor is prevented from proceeding with the Work as a direct result of an Executive Order of the President with respect to the prosecution of war or in the interest of national defense, or by court order. Upon seven days written notice to Contractor and Engineer, City may, without cause and without prejudice to any other right or remedy of City, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

- a. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
- b. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
- c. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
- d. reasonable expenses directly attributable to termination.

Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination. Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the work shall, at the option of the Contractor, be purchased from the Contractor at the actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer. Termination of a contract or a portion thereof shall not relieve the Contractor of his responsibilities for the completed work, nor shall it relieve his surety of its obligation for and concerning any just claim arising out of the work performed.

110.12 COMPLETION.

110.12.1 Partial Utilization. Prior to Final Completion of all the Work, City may use or occupy any completed part of the Work which has specifically been identified in the Contract Documents, or which City, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by City for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

- a. City at any time may request Contractor in writing to permit City to use or occupy any such part of the Work which City believes to be ready for its intended use and complete. If and when Contractor agrees that such part of the Work is complete, Contractor, City, and Engineer will follow the procedures of Subsection 110.12 for that part of the Work.

- b. Contractor at any time may notify City and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and request Engineer to issue a certificate of Final Completion for that part of the Work.
- c. Within a reasonable time after either such request, City, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify City and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Subsection 110.12 will apply with respect to certification of Final Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

110.12.2 Final Completion. When the construction as specified in the contract is substantially complete, the Contractor shall notify the City Engineer in writing that the work will be ready for final inspection on a definite date which shall be stated in such notice. The notice shall bear the signed concurrence of the Engineer having charge of inspection and construction and shall be given at least ten (10) days prior to the date stated for final inspection. If the City determines that the work is as represented, it will make arrangements to have final inspection commenced on the date stated in such notice, or as soon thereafter as practical. That inspection shall constitute the final inspection. If the project is found to be complete, the Engineer will notify the Contractor and will issue a certificate of final completion. Said certificate shall be dated as of the date of final inspection. If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will notify the Contractor in writing of the completion as of the date of final inspection.

110.12.3 Contractor May Stop Work or Terminate.

If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by City or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) City fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to City and Engineer, and provided City or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from City payment on the same terms as provided in Section 110.11.

In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or City has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to City and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this subsection are not intended to preclude Contractor from making a Claim under Section 105 for an adjustment in Contract Price or Contract Time nor otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this subsection.

SECTION III

MEASUREMENT AND PAYMENT

III.1 MEASUREMENT OF QUANTITIES. All work completed under the contract will be measured by the Engineer according to United States standard measure. The Engineer shall be the judge as to the accuracy of any measurements or any approximations made in lieu of accurate determinations and his decisions shall be binding upon both parties.

When specified, pay quantities will be the design lengths, volumes, areas or weights as specified in the contract plans with adjustments thereto. Unless otherwise specified, longitudinal measurements for area computations will be made horizontally. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

A station when used as a definition or term of measurement will be 100 linear feet (31 m). Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

All items which are measured by the linear foot, such as pipe culverts, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise specified. In computing volumes of excavation, the average end area method or other acceptable methods will be used. The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be measured in decimal fractions of inches.

The term "ton" will mean the short ton consisting of 2,000 pounds. All materials which are measured or proportioned by weight shall be weighed on accurate, approved scales by competent, qualified Personnel at locations designated by the Engineer. If material shipped by rail, the car weight may be accepted provided the actual weight of material only will be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty at such times as the Engineer directs, and each truck shall bear a plainly legible identification mark.

Materials specified to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and shall be measured therein at the point of delivery. Vehicles may be of any size or type acceptable to the Engineer, provided the body of the vehicle is of such shape that the actual volume or capacity may be readily and accurately determined. All vehicles shall be loaded to at least a predetermined permanently fixed mark, which defines a known volume or capacity, upon arrival at the point of delivery. No vehicle will be approved unless its capacity, or the volume below the predetermined permanently fixed mark, is in multiples of 0.5 cubic yard (3.8 cu. m.) except that when tail-gate spreader-boxes are used to place aggregate materials under Section 104.9, Load Restrictions, the volume of the spreader-box will be added to the volume of the vehicle.

Whenever possible and unless otherwise specified, pay quantities will be the designed volumes, areas or weights as specified in the contract plans and adjustments thereto. Asphaltic materials will be measured by the gallon or ton.

Net certified scale weights or weights based on certified volumes in the case of shipments by rail, truck or other transport will be used as a basis of measurement, subject to correction when material has been lost in transit, wasted or otherwise not incorporated in the work. When asphaltic materials are shipped by truck or transport, net certified weights or volume, subject to correction for loss or foaming, may be used for computing quantities.

Portland cement will be measured by the barrel, ton or hundred-weight (CWT). The term barrel will mean 376 pounds (173 kg) of cement. Timber will be measured by the thousand feet board measure (MFBM) incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by the time in hours of actual working time and necessary traveling time of the equipment within the limits of the project unless special equipment has been ordered by the Engineer in connection with force account work in which case travel time and transportation to the project will be measured. If equipment has been ordered held on the job on a standby basis by the Engineer, half time rates for the equipment will be paid.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

If conversion is necessary from United States standard units to International System of Units (SI units) or from SI units to U.S. standard units the guidelines, terminology, conversion factors and rules for rounding in the Standard Metric Practice Guide, AASHTO Designation: R 1 will be used.

111.2 SCOPE OF PAYMENT. The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials and for performing all work under the contract in a complete and acceptable manner and for all risk, loss, damage or expense arising out of the nature of the work or the prosecution thereof, subject to the Provisions of Subsection 108.9.2.

If the "Basis of Payment" clause in the specifications relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item.

111.3 COMPENSATION FOR ALTERED QUANTITIES. When accepted quantities of work vary from the quantities in the bid schedule, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the accepted quantities of work done. No allowance, except as provided in Subsection 105.2, will be made for any increased expense, loss of expected reimbursement or loss of anticipated profits suffered or claimed by the Contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the bidder and subsequent loss of expected reimbursements therefore or from any other cause.

111.4 EXTRA WORK. Extra work shall be performed in accordance with the requirements of Section 105.3. Payment for Extra Work will be made as authorized in a Work Change Directive or Change Order.

111.5 PARTIAL PAYMENTS. Provided work is prosecuted in accordance with the provisions of the contract and with such progress as satisfactory to the Engineer, the Engineer will make or cause to be made, the first pay estimate within two calendar months from the date indicated to begin work in the "Notice to Proceed." The cutoff date for each successive pay estimate will be the end of each month thereafter until completion of the contract. Each pay estimate will be an approximation of the proportionate value of the work performed up to and including the date the estimate is made and will be measured in place and labor expended thereon, but no more contract price of the work will be paid in advance of the contract and its acceptance by the City, unless noted otherwise in the instructions to bidder. The amount of said estimate, after deducting retainage and all previous payments, shall be due and payable to the Contractor. The pay estimates will be approximate and all pay estimates and payments shall be subject to corrections in the estimate rendered following discovery of any error in any previous estimates.

Should any defective work or material be discovered or should a reasonable doubt arise as to the integrity of any part of the work completed previous to the final acceptance and payment, there will be deducted from the first estimate rendered after the discovery of such defective or questioned work an amount equal in value to the defective or questioned work, and this work will not be included in a subsequent estimate until the defects have been remedied or the causes for doubt removed.

The payment of the pay estimate shall not be taken as an admission that the work is done or that its quality is satisfactory nor as a release of the Contractor from the responsibility for any portion thereof, but the whole work and all particulars relating thereto shall be subject to revision and adjustment by the Engineer at the time of final acceptance and final payment.

111.6 ELIMINATED ITEMS. Should any items contained in the proposal be found unnecessary for the proper completion of the work, the Engineer may, upon written order to the Contractor, eliminate such items from the contract and such action shall in no way invalidate the contract. When a Contractor is notified of the elimination of items, he will be reimbursed for actual authorized work done and all costs incurred, including mobilization of materials prior to said notification.

111.7 PAYMENT FOR STOCKPILED OR STORED MATERIAL.

111.7.1 General. Payment for stockpiled or stored material will be considered only for materials anticipated to be stored for periods in excess of 90 calendar days. When approved, advance payments may be made for fabricated or natural materials that are to be incorporated in the project when stockpiled materials are stored on the project or in a dedicated stockpile at an approved site outside the limits of the project within the State of Louisiana. Payments shall be limited to durable materials described herein and shall represent a significant portion of the project cost. Perishable articles and small warehouse items are not included. These materials shall meet the requirements of the specifications. Payment for stockpiled or stored materials will not constitute acceptance. It shall be the Contractor's responsibility to protect the material from damage while in storage.

Payment for materials stored outside the State of Louisiana will be considered, subject to approval of the City Engineer. This will generally be limited to adjacent states, except in cases where it will be in the best interest of the City to pay for these materials. If payment for stockpiled materials outside the State will affect the bid price for an item, the contractor shall submit a written request to the City Engineer prior to bidding.

Payment may be made for the invoice price for the materials, which shall not exceed 85 percent of the contract price for the items where the materials are to be incorporated. For fabricated materials purchased from commercial sources and delivered to approved storage, partial payment may be the invoice price plus freight and taxes. The quantity of material for payment will not exceed the total estimated quantity required to complete the project. The amounts advanced on stockpiled or stored materials will be recovered by the City through deductions made on payments as the materials are incorporated in the work.

Partial payment for stockpiled materials shall be requested by the Contractor in writing and the following documents shall be furnished:

1. A copy of the invoices from supplier or manufacturer verifying the cost and quantity of material.
2. If storage is on private property, a copy of the lease or agreement granting the Department right of entry to property.

Within 30 calendar days after payment by the City, the Contractor shall submit a certified copy of invoices from the supplier for each item for which payment has been made. All such invoices submitted shall state the amount received by the supplier as payment in full for the materials. If this certification of

payment is not presented within the 30-day period, the advanced payment will be deducted from future progress payments. Title and ownership of materials for which advancements have been made by the City shall not vest in the City until such materials are incorporated in the work and the work accepted by the City. The making of advancements by the City shall not release the Contractor from the responsibility for any portion thereof.

III.7.2 Fabricated or Manufactured Materials. Fabricated or manufactured materials may include but is not limited to the following: Structural steel, fabricated structural steel items, steel piling; reinforcing steel; electrical equipment; mechanical equipment; precast concrete items; structural timber; timber piling; fencing and guard rail materials; fabricated sign structures and sign panels.

III.7.3 Other Material. These materials will normally be large quantities of natural or manufactured aggregate. The Contractor's request for payment of stockpiled natural material shall give a detailed description of the material, its intended use and location of the site. This material will be inspected and approved after placement in stockpiles on the project. Approval of the stockpiled material will be in writing.

III.8 ACCEPTANCE AND FINAL PAYMENT. Upon completion of the work, the Engineer will execute a certificate of final completion that the whole work provided for in the contract has been completed and accepted under the terms and conditions of the contract and said certificate of final completion will be recorded in the office of the Clerk of Court, Caddo Parish, Louisiana.

The City Engineer will issue the Contractor a letter of final acceptance, and the entire balance found to be due the Contractor, including all retained percentages, will be paid to the Contractor after the City has satisfied itself that the quantities shown on the final estimate are correct, and the Contractor has submitted to the City a "lien-free certificate" from the Clerk of Court, Caddo Parish, Louisiana, to the effect that there are no claims or liens recorded against the said contract. The date of said "lien-free certificate" shall not be prior to the expiration of 45 days after the certificate of final completion was recorded by the Contractor with the Clerk of Court. In addition, if the contract is for a paving assessment project, final payment will be made when the City Council of the City of Shreveport, in legal and regular session convened, approves and accepts the work of the Contractor and authorizes final payment.

Prior to payment of the final estimate, provide deliverables, submittals, and final cleaning as specified in Technical Specification Section 4700 Contract Closeout. Payment of the final estimate shall not operate to release the Contractor or his sureties from liability for any fraud in construction, or in obtaining progress payments, or in payment for materials, labor or other supplies or services incidental to the work, or for any and all claims for damages, loss or injury sustained by any persons through the fault, negligence or conduct of the said Contractor or any of his employees.

PART 2 MATERIALS

SECTION 200

AGGREGATES

200.1 GENERAL. The following specifications set forth the requirements for fine and coarse aggregates for Portland cement concrete, base and surface course aggregates for roadways, asphaltic concrete aggregate, crushed rock, crushed concrete, rip-rap stone. All aggregates shall be clean, hard sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance. Unless otherwise specified, all percentages referred in Section 200 will be determined by weight.

200.2 FINE AGGREGATE:

200.2.1 General. Sand will consist of natural or manufactured granular material or a combination thereof, free of deleterious amounts of organic material, mica, loam, clay and other substances not suitable for the purpose intended.

200.2.2 Gradation. The sand shall conform to following gradations:

PERCENTAGE PASSING SIEVES

<u>Sieve Size</u>	<u>Portland Cement Concrete</u>	<u>Mortar</u>
$\frac{3}{8}$ " (9.5mm)	100	
No. 4	95-100	100
No. 8		
No. 16	45-90	95-100
No. 50	7-30	
No. 100	0-7	0-25
No. 200		0-10

200.2.3 Sand for Portland Cement Concrete. Sand for Portland cement concrete will be washed and will conform to the gradation specified for Portland cement concrete in Subsection 200.1.2. The maximum percentages of deleterious substances shall not exceed the following values:

	<u>Percent</u>
Material Passing No. 200 Sieve	3.0
Coal or Lignite	0.25
Clay Lumps	0.5

200.2.4 Sand for Asphalt Concrete. The sand will consist of clean, hard, durable, siliceous grains graded from coarse to fine and shall be reasonably free from vegetable matter or other deleterious substance. The fraction passing the No. 40 sieve will be non-plastic. The sand equivalent value of the fraction passing the No. 4 shall not be less than 35 when tested in accordance with AASHTO Designation: T 176 (Alternate Method No. 1 - Air Dry). These tests shall be performed when deemed necessary by the Engineer.

200.2.5 Sand for Mortar. The sand will conform to the gradation specified for mortar in Subsection 200.1.2.

200.2.6 Sand for Pneumatic Placed Concrete. Sand for pneumatic placed concrete will be washed and will Conform to the gradation for Portland cement concrete in Subsection 200.1.2. The amount of deleterious substances shall not exceed the limits prescribed in ASTM C-33.

200.2.7 Fill Sand. Fill sand for use in pipe bedding, backfilling of pipe trenches, or for mixing with site excavated earth to improve the compaction of backfill in trenches under pavement shall be a sandy material which will easily compact to a stable foundation. It may be sand dredged from a river, a mixture of sand and gravel and sandy loam or other suitable material approved by the Engineer.

200.2.8 Sand for Pavement Base. Sand for pavement base will be granular material and will conform to Section 200.5.1.

200.3 COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE. Concrete aggregate shall be composed of gravel, crushed rock, crushed slag or a blended mixture of crushed rock and gravel. Blending of crushed rock and gravel shall produce a uniform, consistent percentage of each. All concrete aggregate shall be washed before delivery to the batching plant and shall conform to the following:

Tests	Tests Method No.	Percent (By Weight)
Abrasion Loss	AASHTO T96	40% Max
Soundness	AASHTO T104	
Gravel	5 cycles	15% Max.
Crushed stone	5 cycles	15% Max.
Material Passing the No. 200 Sieve		1.0*
Clay Lumps	AASHTO T112	0.25
Soft Fragments	AASHTO T189	5.0
Iron Ore (Included in Soft Fragments)		
Max. Retained $\frac{3}{4}$ "		1.5
Max. Passing $\frac{3}{4}$ "		0.5
Coal and Lignite	AASHTO T113	1.0
Sticks (Wet)		0.25
Totals: Clay Lumps, Soft Fragments, Coal and Lignite, and Sticks		5.0

* In crushed aggregates, if material finer than the No. 200 sieve consists of the dust of fracture essentially free of clay or shale, the percentage may be increased to 1.5.

- Gravel: This aggregate shall be reasonably free of clay coating of any character. Gravel which contains disintegrated or soft stone or shale, or excess of flat pieces, shall not be used.
- Crushed Slag: Crushed slag shall consist of angular fragments reasonably free from flat or elongated pieces.

The crushed slag shall have a minimum dry rodded weight of 70 pounds per cubic foot when tested in accordance with AASHTO Designation: T 19, and shall be properly cured and stored such that it results in a chemically inert and stable aggregate. Because of its high absorption property, slag in stockpiles shall be kept uniformly wet.

Crushed slag shall contain not more than 10 percent by weight of glassy particles, and show an abrasion loss of not more than 40 percent. Higher percentages may be allowed for slags having demonstrated a satisfactory service record, at the discretion of the Engineer.

Concrete coarse aggregate will be designated by grade and shall conform to the following gradations, tested in accordance with AASHTO T27.

CONCRETE AGGREGATE GRADATIONS

Percentage Passing Sieves (By Weight)

Sieve Size (mm)	Grade D	Grade B	Grade A
2 ½" (63.0)	100	-	-
2" (50.0)	90 - 100	100	-
1 ½" (35.5)	-	85 - 100	100
1" (25.0)	40 - 80	-	95 - 100
¾" (19.0)	-	20 - 88	-
½" (12.5)	-	-	25 - 60
No. 4	0 - 6	0 - 6	0 - 10
No. 8	-	-	0 - 5

200.4 BASE COURSE AGGREGATES

200.4.1 Crushed Stone.

200.4.1.1 General. Crushed stone shall consist of fragments of hard, durable particles of stone showing an abrasion loss of not more than 45 percent, containing not more than 5 percent of soft, friable material, and shall be free from an excess of flat or elongated pieces.

200.4.1.2 Grading. The aggregate shall be uniformly graded and shall conform to the following gradation, tested in accordance with AASHTO 27.

<u>Crushed Stone Base</u>	
<u>Sieve Size (mm)</u>	<u>Percentage Passing Sieve</u>
1 ½" (37.5)	95 - 100
¾" (19.0)	65 - 95
No. 4	0 - 15

200.4.1.3 Quality Requirements. The material shall conform to the following:

<u>Tests</u>	<u>Test Method</u>	<u>Requirements</u>
Abrasion Loss	AASHTO T96	45% Max.
Soundness	AASHTO T104	15% Max.

200.3.1 Crushed Concrete Base. Crushed concrete shall conform to the following grading requirements:

<u>Sieve Size</u>	<u>Percentage Passing Sieve</u>
1 1/2 "	100
3/4 "	70
No. 4	35 - 65
No. 200	5 - 12

200.4 SURFACE COURSE AGGREGATE.

200.4.1 Gravel. Gravel shall consist of hard, durable, siliceous particles reasonably free of sticks and other deleterious matter, and shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing (By Weight)</u>
1 1/2 " (38.1 mm)	95 to 100
No. 4	0 to 15
Clay & Silt	2 percent max.

Gravel shall show an abrasion loss of not more than 45 percent.

200.4.2 Crushed Stone. Crushed stone shall consist of fragments of hard, durable particles of stone showing an abrasion loss of not more than 45 percent, containing not more than 5 percent soft, friable material, and shall be free from an excess of flat or elongated pieces. The material shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing (By Weight)</u>
1 1/2 " (37.5 mm)	95 to 100
3/4 "	0 to 15
Clay & Silt	2 percent max.

200.4.3 Binder. The binder shall be siliceous material conforming to the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing (By Weight)</u>
No. 4	85 to 100
No. 40	65 to 100
No. 200	10 to 60

Binder shall not contain more than a total of 4 percent by weight of foreign matter. It shall meet the following physical characteristics:

Liquid Limit (Max)	35
Plasticity Index	4-12

200.4.4 Sand Clay Gravel. Sand clay gravel shall be a mixture of sand, clay, and gravel; a mixture prepared by either the mixing of gravel or crushed stone, sand and binder; or by the addition of gravel or crushed stone and/or binder to natural sand clay gravel.

The mixture as determined by visual inspection shall be reasonably free from deleterious materials. The combined materials shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing (By Weight)</u>
1 1/2 "	95 to 100
3/4 "	40 to 75
No. 4	20 to 50
No. 200	12 to 25

The fraction of sand clay gravel passing the No. 40 sieve, shall show the following physical characteristics:

Liquid Limit (Max)	35
Plasticity Index	0-12

The binder material used for preparation of an artificial mixture of sand clay gravel shall not have a plasticity index in excess of the plasticity index indicated above for the final product.

When tested by the Los Angeles abrasion test, the fraction of the sand clay gravel retained on the No. 4 sieve shall show an abrasion loss of not more than 45 percent.

200.5 ASPHALTIC SURFACE TREATMENT AGGREGATE. Aggregates for asphaltic surface treatment shall be from a source approved by the Department and may be uncrushed gravel; crushed aggregate (gravel, stone or slag); a combination of crushed and uncrushed gravel; or expanded clay aggregate.

200.5.1 Crushed Gravel. This aggregate shall consist of clean, tough, durable stone and shall be crushed and screened to conform to the gradation specified. A minimum of 80 percent of the crushed gravel retained on the No. 10 sieve shall have one or more fractured faces. Crushed gravel shall not show an abrasion loss of more than 40 percent and shall show a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of the magnesium sulfate soundness test.

200.5.2 Crushed Stone. This aggregate shall consist of clean, tough, sound, durable particles of stone. The particles of stone shall be reasonably free from dust, vegetable or other deleterious matter and shall not show an abrasion loss of more than 40 percent. The stone shall be reasonably free from an excess of flat or elongated particles and shall show a soundness loss of not more than 15 percent by weight when subjected to 5 cycles of the magnesium sulfate soundness test.

200.5.3 Crushed Slag. Crushed slag shall consist of angular fragments reasonably free from flat or elongated pieces, dirt or other objectionable matter. The crushed slag shall have a minimum dry rodded weight of 70 pounds per cubic foot when tested in accordance with AASHTO Designation: T 19, and shall be properly cured and

stored such that it results in a chemically inert and stable aggregate.

Crushed slag shall contain not more than 10 percent by weight of glassy particles, and show an abrasion loss of not more than 40 percent. Higher percentages may be allowed for slags having demonstrated a satisfactory service record, at the discretion of the Engineer.

200.5.4 Uncrushed Gravel. This aggregate shall consist of clean, tough, durable stone reasonably free from sticks and clay coating. Gravel shall be reasonably free from an excess of flat or elongated particles of stone and shall show an abrasion loss of not more than 40 percent and shall show a soundness loss of not more than 15 percent when subjected to 5 cycles of magnesium sulfate soundness test.

200.5.5 Expanded Clay Aggregate. This aggregate shall be manufactured by the rotary kiln process and shall consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated particles or other deleterious substances. Expanded clay aggregate shall show an abrasion loss of not more than 40 percent. The soundness loss shall not exceed 10 percent by weight when subjected to 5 cycles of the magnesium sulfate soundness test using No. 4 to $\frac{3}{8}$ inch and $\frac{3}{8}$ inch to $\frac{3}{4}$ inch size aggregate.

200.5.6 Gradation Requirements. All the above types, when tested, shall conform to the gradation requirements specified in following table.

Percent Passing (By Weight)

	Size 1 (Fine)		Size 2 (Fine)		Size 3
U.S. Sieve (mm)	Uncrushed Gravel or <u>Crushed</u> <u>Aggregate</u>	Expanded Clay <u>Aggregate</u>	Normal Gradation 3 Application Surface <u>Treatment</u>	Gradation for 2 Application Surface Treatment (Shoulders only)	
1 $\frac{1}{2}$ " (37.5)	100	100	-	-	
1" (25.0)	85 - 100	95 - 100	-	-	
$\frac{3}{4}$ " (19.0)	40 - 80	70 - 90	100	100	
$\frac{3}{8}$ " (16.0)	-	-	95 - 100	95 - 100	
$\frac{1}{2}$ " (12.5)	0 - 15	-	-	60 - 90	100
$\frac{3}{8}$ " (9.5)	-	-	-	-	90 - 100
No. 4	-	0 - 5	0 - 7	0 - 10	15 - 60
No. 10	-	-	-	-	0 - 15
No. 16	-	-	-	-	0 - 5

* Size 2 cover material for use with two application surface treatment for shoulders shall conform to the gradation requirements referenced to this note.

200.6 ASPHALTIC CONCRETE AGGREGATE.

200.6.1 Type I Mixture: The aggregate shall consist of crushed gravel, crushed slag, crushed stone or a combination of these materials, sand and mineral filler.

200.6.1.1 Crushed Gravel: Crushed gravel shall be from a source approved by the City and shall consist of clean, hard, tough, durable fragments, screened and crushed to meet the grading requirements. Gravel shall not show an abrasion loss of more than 40 percent. It shall show a soundness loss of not more than 15 percent by

weight when subjected to 5 cycles of the magnesium sulfate soundness test.

200.6.1.2 Crushed Stone: This aggregate shall be from a source approved by the Department and shall consist of clean, hard, durable fragments reasonably free from flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter. Crushed stone shall not show an abrasion loss of more than 40 percent.

When subjected to 5 cycles of the magnesium sulfate soundness test, the weighted loss shall not exceed 15 percent. Higher percentages may be allowed for stone having a satisfactory service record, at the discretion of the Engineer.

200.6.1.3 Crushed Slag: This aggregate shall be from a source approved by the City and shall consist of angular fragments, reasonably free from flat or elongated pieces.

The crushed slag shall have a minimum dry rodded weight of 70 pounds per cubic foot when tested in accordance with AASHTO Designation T 19, and shall be properly cured and stored such that it results in a chemically inert and stable aggregate.

Crushed slag shall contain not more than 10 percent by weight of glassy particles, and show an abrasion loss of not more than 40 percent. Higher percentages may be allowed for slags having demonstrated a satisfactory service record, at the discretion of the Engineer.

200.6.1.4 Sand: Sand shall consist of clean, hard, durable, siliceous grains graded from coarse to fine and shall be reasonably free from vegetable matter or other deleterious substance. The fraction passing the No. 40 sieve shall be non-plastic.

The sand equivalent value of the fraction passing the No. 4 sieve shall not be less than 35 when tested in accordance with AASHTO Designation: T 176 (Alternate Method No. 1 - Air Dry). These tests shall be performed when necessary by the Engineer.

200.6.2 Type 3 Mixture: The aggregate shall consist of the following:

- a. Wearing Course Mixture: Crushed gravel, crushed slag, crushed stone, combined with screening of gravel, stone, slag or other approved materials; sand; and mineral filler.
- b. Binder Course: The aggregate shall be the same as Type 1 binder course described under Subsection 200.6.1.

All materials for Type 3 mixes shall conform to the requirements under Subsection 200.6.2.

Screening shall be made by crushing any of the approved aggregates which prior to crushing conformed to the requirements under Subsection 200.6.1.

The Type 3 wearing course mixtures shall contain a minimum of 15 percent screening based on total aggregates as approved by the engineer; however, the amount of screening required may exceed the minimum if deemed necessary to meet the optimum physical properties.

The screening shall be a natural crusher run material meeting the following gradation. When gravel is used for screening, it shall be washed gravel and shall not have more than 10 percent passing the No. 4 sieve prior to crushing and shall meet the following gradation requirements after crushing.

<u>Sieve</u>	<u>Percent Passing (By Weight)</u>
$\frac{3}{8}$ " (9.5 mm)	100
No. 4	90 - 100
No. 40	10 - 45

The screening shall be stockpiled separately and fed into the plant through a separate cold feed. The percent of screening used in the mix will be determined volumetrically at the cold feed.

This measurement will be made by the ratios of the gate openings at the cold feed for plants that have a constant feed for all the cold feed bins. For plants that have variable speed cold feed belts, the percent of screening will be determined by measuring the percent of screening by volume of the total volume of aggregate on a given section of belt.

The sand shall conform to the requirements under Subsection 200.6.1.4.

200.6.3 Type 4 Mixture: The aggregate shall consist of expanded clay aggregate, sand and mineral filler. These materials shall meet the following requirements.

Expanded clay aggregate shall be manufactured by the rotary kiln process and consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated pieces or other deleterious substances. Expanded clay aggregate shall not show an abrasion loss of more than 40 percent. The expanded clay aggregate shall have a dry rodded weight per cubic foot of not more than 50 pounds when tested in accordance with AASHTO Designation: T 19. The percent loss shall not exceed 10 percent after 5 cycles by the magnesium sulfate soundness test.

Sand shall conform to the requirements specified under Subsection 200.6.1.4.

200.6.4 Type 5 Mixtures: Type 5A - The aggregate shall consist of gravel, slag, stone or expanded clay, sand and mineral filler when needed.

Type 5B - The aggregate shall consist of gravel, slag, stone, expanded clay and sand; or sand clay gravel.

Pit run sand clay gravel may be used in Type 5B mixes provided the material is separated into two distinct sizes prior to final mixing. The separation shall be done by using a No. 4 screen or other approved sizes. For batch plants the screening process must be adequate to satisfy this requirement.

200.6.5 Mineral Filler: Mineral filler shall consist of limestone dust, pulverized lime, silica dust, shell dust, portland cement, cement stack dust or other approved materials.

Blending of pulverized anhydrous calcium sulfate (anhydrite) with the mineral fillers will be permitted provided the anhydrite does not constitute more than 30 percent of any blend with one or more of the other approved fillers.

Anhydrite shall not be contaminated with clay or other plastic mineral matter and shall conform to the requirements herein for mineral fillers.

The portion of pulverized anhydrite passing the No. 200 sieve shall not constitute more than 25 percent of the total material passing the No. 200 sieve, including natural fines, in any paving mixture.

Anhydrite shall not constitute more than 2 percent of the total aggregate, including all sizes, for any paving mixture.

The cement stack dust shall consist of material collected from waste rotary kiln gases discharged through a collector of a cement plant.

Limestone dust, silica dust, shell dust, cement stack dust, or a blend of one of these fillers with anhydrite dust, or a blend of anhydrite with hydrated lime or portland cement shall meet the following gradation requirements.

<u>Sieve</u>	<u>Percent Passing (By Weight)</u>
No. 30	100
No. 80	95 - 100
No. 40	70 - 100
No. 270	10 - 45

Mineral dust collected in bag houses of asphaltic concrete plants may be used as mineral filler in accordance with the following requirements. This type mineral filler that is produced by each plant must be approved by the Laboratory prior to use and the quantity required will be determined by the Materials Laboratory. Provisions must be made at the plant so the amount of mineral dust from the bag houses that is added to the mixture can be readily determined.

When the quantity of mineral dust being produced is less than that required in the mixture design, this material can be supplemented by the addition of an approved commercial filler.

Whenever mineral fillers are to be approved for use in asphaltic mixtures, the Laboratory will prepare mixtures of aggregate, filler and asphalt in proportions to meet the requirements of mixes being utilized, and this mixture shall have an index of retained Marshall stability of at least 75 percent, and a maximum of 1.0 percent volumetric swell, as determined in accordance with Louisiana DOTD Designation: TR 313.

Whenever portland cement or hydrated lime is used, tests for gradation requirements will not be made.

PART 2

SECTION 200

AGGREGATES

200.7 RIP-RAP STONE. Stone for rip-rap shall be quarry stone or cobblestone. Quarry stone shall be angular, and cobblestone shall be rounded. Stone shall be of such shape as to form a stable protection structure of the required section. Cobblestone shall not be used on slopes steeper than 2 to 1. Flat or elongated shapes will not be accepted unless the thickness of the individual pieces is at least one-third the length.

Stone shall be sound, durable, hard, resistant to abrasion and free from lamination, weak cleavage planes, and the undesirable effects of weathering. It shall be of such character that it will not disintegrate from the action of air, water, or the conditions to be met in handling and placing. All material shall be clean and free from deleterious impurities, including alkali, earth, clay, refuse, and adherent coatings. When tested in accordance with AASHTO T85, the solid weight of the stone shall be at least 140 pounds Per cubic foot (based on bulk specific gravity) and the absorption shall not exceed 2 percent.

Visual elevation of the quarry, including examination of blast samples and diamond drill core samples, suitable tests and service records may be used to determine the acceptability of the stone. The contractor shall notify the Engineer in writing of the intended source of stone at least 60 days prior to use.

Unless otherwise specified, broken concrete may not be used for rip-rap stone. If broken concrete is specified as a substitute, then broken concrete conforming to these materials and gradation requirements may be used for rip-rap provided its solid weight is at least 130 pounds per cubic foot (based on bulk specific gravity) and is free of protruding reinforcement.

200.7.1 Gradations: Stone meeting the above requirements shall be graded within the following limits. If not otherwise specified or indicated on the plans, Type A Stone shall be furnished.

Percent By Weight	Stone Weight (Pounds)		
	Type A	Type B	Type C
0 - 10	26 to 36	88 to 122	190 to 230
40 - 60	9 to 14	28 to 46	65 to 100
20 - 40	4 to 9	14 to 28	35 to 65

Spalls will include all quarry chips and fines weighing less than the specified minimum that are retained on a rock fork whose tines have a clear spacing of one inch.

SECTION 201

CONCRETE, MORTAR AND RELATED MATERIAL

201.1 PORTLAND CEMENT CONCRETE

201.1.1 Requirements

201.1.1.1 General. Concrete will consist of portland cement, or portland-pozzoland cement, concrete aggregates, water, and admixture when approved for use, in accordance with these provisions. Concrete will be specified by class or by compressive strength. When specified by class, the concrete will be designated by a letter. The concrete class used will be in accordance with Subsection 201.1.1.2, unless otherwise specified. Concrete specified by compressive strength will be designed by the contractor in accordance with Subsection 201.1.1.3. Approved admixtures will be in accordance with Subsection 201.1.5. Additional cement is permitted to obtain high early strength in concrete, except that total cement shall not exceed 700 pounds of cement per cubic yard (415 kg/m³) unless otherwise approved by the Engineer.

201.1.1.2 Concrete Specified by Class. The concrete class and maximum slump for the various types of construction shall be as designated in the following table. The exact proportions of aggregates and water to be used in the concrete will be determined by the Engineer from tests of the material to be used.

(see following chart)

CONCRETE PROPORTION TABLE

Class Type of Concrete	Average Compressive Strength psi at 28 Days	Grade of Coarse Aggregate	Minimum Bags of Cement of 94 lbs. each to one Cu. Yd. of Concrete	Maximum Water per Sack of Cement (a) (Gallons)	Air Entrainment Total Air (percent by volume)((c)	Slump Range (Inches)		
						Non-Vibrated Placing	Vibrated Paving	Slip Form Paving Placing (b)
Structural Class								
A	3,800	A	6.0	6.0	5 ± 2	2-5	2-4	I-1.5
D	3,300	A,B, or D	5.0	6.6	5 ± 2	2-5	I-3	N.A.
R	2,000	A,B, or D	4.0	8.0	5 ± 2	2-5	I-3	N.A.
S	3,800	A	7.0	6.0	5 ± 2	6-8	N.A.	N.A.
Pavement Class								
B	4,000 (d)	B	5.8	6.0	5 ± 2	N.A.	2-4	I-2.5
C	4,000 (d)	B (Crushed Slag)	6.0	6.0	5 ± 2	N.A.	2-4	I-2.5
D	4,000 (d)	B	5.4	6.0	5 ± 2	N.A.	2-4	I-2.5
E	4,000 (d)	B	5.0	6.0	5 ± 2	N.A.	2-4	I-2.5

N.A. - Not Applicable

- (a) The maximum water-cement ratio (gal./sack) shall be reduced 5% when a water reducing admixture is used, and 10% when an air-entraining admixture, or air-entraining and water-reducing admixtures, is used.
- (b) Also slump range for other concrete placed by extruded methods when it is allowed or specified.
- (c) Total air content ranges when air entrainment is used.
- (d) Average compressive strength for pavement type concrete shall be 3,600 psi when air entrainment is used.

201.1.1.3 Concrete Specified by Compressive Strength. When so specified, the contractor shall determine the mix proportions of concrete specified on the plans by its 28-day compressive strength within the minimum size coarse aggregate, and admixture limitations designated herein or in the special provisions.

Calcium chloride may be used only with the approval of the Engineer. Admixtures proposed for use will be evaluated in accordance with Subsection 201.1.5.

The proposed mix design will be evaluated from field tests of a trial batch conforming to the size of load, materials, proportions, slump, mixing and placing equipment and procedures to be used in the actual work. The trial batch procedure herein may be waived when test data of prior performance of the proposed mix designs presented by the contractor and approved by the Engineer. The contractor may utilize any strength data on file with the Department for this purpose.

When approved by the Engineer, trial batches may be placed in the work at designated locations where concrete of a lower quality is specified. Concrete so placed will be considered for purpose of payment to be of the type of concrete specified at that location.

Eight cylinders shall be molded from the trial batch containing the maximum water content indicated by the mix design. Four of the cylinders shall be tested at 7 days in order to establish 7-day average compressive strength information. The remaining four cylinders shall be tested at no more than 28 days after molding and the average compressive strength of the four cylinders shall be at least 600 psi (4.14MPa) greater than the specified strength. The minimum strength of any one cylinder shall not be less than the specified strength.

The placing of concrete specified by compressive strength shall not begin until the mix design has qualified in accordance with the aforesaid test criteria. Should the source of materials or established procedures change, new trial batches may be required.

201.1.1.4 Test for Portland Cement Concrete. Portland cement concrete will be sampled and tested in accordance with the following:

AASHTO

(1) Sampling Fresh Concrete	T-141
(2) Obtaining Drilled Cores	T-24
(3) Molding and Curing Specimens	T-23
(4) Compressive Strength	T-22
(5) Flexural Strength	T-97
(6) Slump	T-119
(7) Air Content	T-196 or T-152
(8) Unit Weight Yield	T-121
(9) Setting of Mortar	T-131

A compressive strength test will consist of the average strength of 2 cylinders fabricated from a single load of concrete except that, if any cylinder should show evidence of improper handling, molding, or testing, said cylinder will be discarded and the strength test shall consist of the strength of the remaining cylinder.

The frequency of sampling will be determined by the Engineer. The contractor shall afford the Engineer all reasonable access, without charge, for the procurement of samples of fresh concrete at time of placement.

Concrete specified by class under Subsection 201.1.1.2 shall attain the minimum 28-day strength designated.

Concrete specified by compressive strength under Subsection 201.1.1.3 shall attain the following 28-day strength: The average of any 3 consecutive strength tests shall be equal to or greater than the specified 28-day strength.

Not more than 10% of the tests shall be less than the specified 28-day strength. No test shall be less than 85% of the specified 28-day strength.

201.1.2 Portland Cement. At contractor's option, unless otherwise specified, all cement to be used or furnished shall be Type I, II or III conforming to ASTM C150 or Type IP (Portland - pozzolan) conforming to ASTM C-595. However, only one type of cement will be used on one Project. The contractor shall furnish a Certificate of Compliance signed by the manufacturer identifying the cement and stating that the cement complies with these requirements. Supporting test data will be furnished when requested by the Engineer.

Whenever suitable facilities approved by the Engineer are available for handling and weighing bulk cement, such facilities will be used. Otherwise, the cement shall be delivered in original unopened sacks that have been filled by the manufacturer. They will be plainly marked with the manufacturer's name or brand, cement type and weight.

Cement shall be stored in such a manner as to permit ready access for the purpose of inspection and sampling, and suitably protected against contamination or moisture. Should any cement delivered show evidence of contamination or be otherwise unsuitable, the Engineer may reject it and require that it be removed from the site.

All portland cement used in concrete for any individual structure shall be of the same brand and type unless otherwise approved by the Engineer.

201.1.3 Aggregates. Aggregates shall conform to the requirements prescribed in Subsections 200.1 and 200.2 and shall be approved by the Engineer prior to use. Aggregate shall be of such character that it will be possible to produce workable concrete within the limits of slump and water content in Subsection 201.1.1.2.

Methods of handling materials resulting in segregation, degradation or the combining of materials which results in failure to meet specifications shall not be permitted. The free moisture content of sand shall not exceed 8% at the time of batching.

Aggregates shall be non-reactive when tested in accordance with ASTM C 289 and evaluated in accordance with Appendix A-1 of ASTM C 33. Aggregates found to be potentially reactive may be used only upon written approval of the Engineer.

201.1.4 Water. Water used for concrete shall not contain deleterious substances. Water shall not contain an amount of impurities that will cause a change in the time of setting of portland cement of more than 25% nor a reduction in relative mortar strength at 7 and 28 days of more than 10% compared to results obtained with distilled water.

201.1.5 Admixtures. Admixture shall be used as specified or approved by the Engineer. The admixture shall be measured into each batch or load in liquid form by a mechanical dispensing device and method approved by the Engineer. The quantity dispensed shall not vary more than 5% from the quantity specified. If more than one admixture is used, each shall be dispensed by separate equipment in liquid form.

Calcium chloride shall not be used in pre-stressed concrete. Admixtures containing chloride ions in excess of one percent by weight of admixture shall not be used in pre-stressed concrete. Calcium chloride may be used in reinforced concrete only upon approval of the Engineer. Admixtures to be used in grouting ducts in pre-stressed units shall not contain chloride ions in excess of 0.25% by weight of admixture.

Samples of the admixtures proposed for use shall be submitted by the contractor to the Engineer sufficiently in advance of their intended use to determine compliance with specified requirements. Approval to use an admixture shall not relieve the contractor of the designated concrete strength requirements.

(a) Air-entraining Admixtures.

Air-entraining Admixtures shall conform to AASHTO M-154. Tests by an approved laboratory shall provide sufficient data to determine the time- strength characteristics to mix with the admixture.

When the air-entraining agent consists of a vinsol resinwater solution that has been neutralized with caustic soda (sodium hydroxide), the contractor may use such air-entraining admixtures without presentation of test data. In lieu of test data, the contractor shall furnish a certificate signed by the manufacturer attesting to this fact and stating the ratio of sodium hydroxide to vinsol resin, the percentage of solids based on the residue dried at 105°C, and that no other additive or chemical agent is present in this solution.

The concentration of dilution of the admixture shall be such that it is dispensed into each batch of concrete at a rate of not less than 1/2 fluid ounce per 100 lbs. (33 ml per 100 kg) of cement.

Adjustments shall be made in the weights of the aggregates used per batch to compensate for changes in yield due to air-entrainment.

If the contractor elects to use an air-entraining admixture, the Engineer may require that additional cement be added to the concrete mixture when the air content exceeds 5%. In no case shall air content exceed percent indicated in the Concrete Proportion Table (201.2).

The air content shall not deviate from the percentage specified or permitted by more than 2 percentage points.

Water Reducing, Set Retarding and Accelerating Admixtures.

Water reducing, set retarding, and accelerating admixtures other than calcium chloride shall conform to AASHTO M-194, and shall not be used in greater dosages than those recommended by the manufacturer, or permitted by the Engineer. The permitted dosage of the admixture shall not exceed that which will result in an increase in the drying shrinkage of the concrete in excess of 20% when used in precast and prestressed concrete, or 10% when used in any other structural concrete.

The strength of concrete containing the admixture in the amount proposed shall, at the age of 48 hours and longer, be not less than that of similar concrete without the admixture.

The admixture shall not adversely affect the specified air content, unless permitted by the Engineer.

(b) Calcium Chloride.

When calcium chloride is permitted or required to accelerate setting time and to reduce the time necessary for the concrete to reach its specified strength, it may be processed from either a brine solution or flake. If prepared from flake, it shall conform to AASHTO M 144. The calcium chloride solution shall contain not less than 32% of anhydrous calcium chloride and the hydrogen ion concentration (pH) shall be not more than 10.4 nor less than 6.0. Calcium chloride solution shall be used at the rate of not more than 3 pints per 100 pounds (3.13 l per 100 kg) of cement.

201.1.6 Proportioning

201.1.6.1 General. Aggregates and cement shall be proportioned by weight except that when the amount of concrete required for any one contract is 10 cubic yards (7.7 m³) or less, the materials may be measured by volume. Materials that are proportioned by volume shall be measured in containers of known capacity.

Weigh hoppers shall be charged from bins located directly over them or from conveyor belts. When conveyor belts are used, there shall be a separate belt for each size aggregate.

Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the ingredients are released for discharge. The cement hopper shall be attached to a separate scale for individual weighing.

The amount of water to be added to the mixture shall be measured into the mixing drum through a valve with a

positive cut-off. When water is measured by weight, it shall be weighed on a separate scale.

201.1.6.2 Combined Aggregate Gradings. The combined aggregates shall conform to the gradings specified in the following table:

COMBINED GRADINGS FOR PORTLAND CEMENT CONCRETE

PERCENTAGE PASSING SIEVES					
Sieve Size	Grading A	Grading B	Grading C	Grading D	Grading E
2"	100	100			
1 1/2"	95-100	95-100	100		
1"	64-80	80-96	95-100		
3/4"	55-71	64-80	77-93	100	100
3/8"	37-53	40-52	50-70	92-100	90-100
No. 4	32-42	35-45	39-51	42-60	60-80
No. 8	25-35	28-38	31-41	33-47	50-70
No. 16	18-28	21-31	22-23	22-38	33-53
No. 30	10-18	10-20	12-22	17-25	19-35
No. 50	3-9	3-9	3-9	6-12	5-15
No. 100	0-3	0-3	0-3	1-5	2-6
No. 200	0-2	0-2	0-2	0-2	0-2

201.1.6.3 Concrete Consistency. The amount of water added at the mixer shall be regulated to take into account the free water in the aggregates. Free water is defined as the total water minus the water absorbed by the aggregate in a saturated surface-dry condition.

The amount of water used in the mixture shall not exceed the amount necessary to permit practical placement and consolidation of the concrete. Total free water in the mixture shall not exceed an amount producing the maximum slump specified in Subsection 201.1.1.2. When adverse or difficult conditions affect the placement of concrete, the Engineer may authorize a greater slump to be used, provided the cement is increased. Water shall be added at a ratio not to exceed 32 pounds per 100 lbs. (32 kg/100 kg) of added cement per cubic yard of concrete, and such additional water and cement shall be at the contractor's expense.

201.1.7 Mixing and Transporting

201.1.7.1 General. Machine mixing will be required in all cases other than those in which it would obviously prove to be impractical, in which event hand-mixing will be permitted. Mixing shall be commenced as soon as possible after the cement is placed in contact with the aggregates, but in no event shall the intervening period exceed 30 minutes.

All concrete mixers shall be of such design and construction and so operated as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed. Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced. Mixers shall not have any aluminum parts which will have direct contact with concrete.

201.1.7.2 Paving and Stationary Mixers. Paving and stationary mixers shall be equipped with an accurate automatic timing device so designed and constructed as to lock the discharge lever before aggregate and cement enter the drum, and release such lever only after the specified mixing time has elapsed. The regulation of the setting of said device shall be under the supervision of the Engineer. Water control equipment shall also be provided with each concrete mixer.

The proper proportions of aggregate, cement, and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than one minute after all such materials are in the drum. The minimum mixing time per batch for reinforced concrete, however, shall not be less than 1½ minutes. The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall exceed neither the water level capacity of the mixer nor the manufacturer's guaranteed capacity of the mixer.

201.1.7.3 Transit Mixers. Transit mixers shall be equipped with an automatic device for recording the number of revolutions of the drum during the mixing period. Each mixer and agitator shall have attached thereto in a prominent place, a metal plate or plates, installed by the manufacturer on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades. Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this subsection, the amount of materials charged into the mixer shall be reduced.

The drum of the mixer shall be completely emptied of any previously mixed load. The proper proportions of aggregate, cement, and water for each load of concrete shall be placed in the mixer and shall be mixed therein for not less than 70 nor more than 100 revolutions of the drum or blades at the speed designated by the manufacturer of the equipment as mixing speed. Additional revolutions of the drum shall be at the speed designated by the manufacturer of the equipment as agitating speed. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum.

When concrete is being placed for pavement or concrete structures, all wash water shall be emptied from the mixer before any portion of the succeeding load is placed therein. For all other work, the mixer shall be empty or may carry 10 gallons (38 l) of water in the drum. Adequate control of ready-mixed concrete will normally require that additional water be added and mixed into the batch at the point of discharge. Water so added shall be mixed into the load for a minimum of 30 revolutions at the rated mixing speed. Water shall not be added to the load during transit. The total elapsed time between the addition of water at the batch plant and discharging the completed mix shall not exceed 90 minutes. Under conditions contributing to quick setting, the total elapsed time permitted may be reduced by the Engineer.

The Engineer shall be provided with a legible certified weigh-master's certificate (delivery ticket). When mix proportions have been designated for a project and are identified by number, the Engineer may accept a legible certified weighmaster's certificate which shall contain the following information: Name of Vendor, Name of Contractor, Project Location, number of cubic yards in the load, mix number, amount of water added at the plant (including water in aggregates) allowable water, time and rate of batching.

When the mix proportions are not designated by number, or when required by the Engineer, the certificate shall contain the following additional information:

1. Actual weights of cement and of each size of aggregate
2. Brand and type of cement
3. Brand, type, and amount of admixture

Space shall be provided on the certificate so that amount of water added on the job may be indicated.

201.1.7.4 Hand Mixing. Hand mixing will be permitted when the amount of concrete required for any one job is one cubic yard (0.8 m) or less. Hand mixed concrete shall be mixed on a water-tight platform or in a mortar box in batches not to exceed 1/3 cubic yard (0.3 m) each. The aggregates shall first be spread in a uniform layer over which the required quantity of cement shall be evenly distributed. The entire batch shall be turned with shovels until the ingredients are thoroughly blended before adding the water. After adding the proper amount of water, the batch shall again be turned with shovels until a uniform consistency is obtained. Methods of hand mixing which allow the loss of mixing water will not be permitted.

201.1.7.5 Transporting Batched Materials and Mixed Concrete. The compartments of trucks or other equipment used for the purpose of transporting proportioned dry aggregate and cement, or mixed concrete, shall be suitably constructed to adequately protect and prevent loss or leakage of the contents during charging, transit or discharging.

201.2 STEEL REINFORCEMENT FOR CONCRETE

201.2.1 General. The following specifications set forth the requirements for bar, wire, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the Drawings or otherwise prescribed. Before being placed in any concrete work, it shall be cleaned thoroughly of all rust, mill scale, mortar, oil, dirt, or coating or any character which would be likely to destroy, reduce, or impair its proper bonding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the Engineer as conforming with requirements prescribed therefore. When required by the Engineer, the contractor or vendor shall furnish samples therefore for testing and notify the Engineer as to when and where they will be available. Such samples shall be furnished at the expense of the contractor or vendor, but the cost of any testing that may be required will be borne by the Department. Samples shall only be taken in the presence of the Engineer. The contractor shall furnish a certified mill test report for each heat or size of steel when required by the Engineer.

201.2.2 Reinforced Steel. Unless otherwise specified, reinforcing steel shall be either Grade 40 or Grade 60 billet steel conforming to ASTM A 615. Varying grades shall not be used interchangeably in structures.

Steel bending processes shall conform to the requirements of the Manual of Standard Practice of the Concrete Reinforcing Steel Institute. Bending or straightening shall be accomplished so that the steel will not be damaged. Kinked bars shall not be used.

201.2.3 Wire Reinforcement. Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A 82.

201.2.4 Wire Mesh Reinforcement. Mesh reinforcement shall conform to ASTM A IS5. The gage of the wire and the dimensions of the mesh will be indicated in the Drawings or specified elsewhere. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during the necessary handling. The effective cross-sectional area of the wire shall be equal to that specified or indicated on the Drawings.

201.2.5 Bar Mats. Fabricated Steel Bar or Rod Mat for concrete reinforcement shall conform to requirements of ASTM A 184.

201.2.6 Wire Ties. Wire for ties shall be black, annealed, not lighter than 16 gauge.

201.2.7 Prestressing Steel. Prestressing steel shall be high-tensile wire conforming to ASTM A 421, a high-tensile wire strand conforming to ASTM A 416, or high-tensile strength alloy bars conforming to the following requirements:

The cross-sectional steel area of wire strand shall be within 0.005 square inch (3.2 mm²) of the nominal steel area

shown in Table I of ASTM A 416 and in Table I in this subsection.

In the event the contractor elects to use a wire strand manufactured to a higher breaking strength than is specified in ASTM A 416, such higher strength strand shall, in addition, conform to the following requirements:

TABLE I - BREAKING STRENGTH REQUIREMENTS

Nominal Diameter (Inches)	3/8	7/16	1/2	(mm)	9.5	11	12.7
Breaking Strength (Lbs.), min.	23,000	31,000	41,300	(kN)	102.3	137.9	183
Nominal Steel Area (Sq. In.)	0.085	0.116	0.155	(mm ²)	55	75	100
Nominal Weight, 1000 ft., (Lbs.)	292	400	525	(305m) (kg)	132.5	181.6	238

TABLE II - YIELD STRENGTH REQUIREMENTS

Nominal Diameter (Inches)	3/8	7/16	1/2	(mm)	9.5	11	12.7
Initial Load (Lbs)	2,300	3,100	4,130	(kN)	10.2	13.8	18.3
Minimum Load 1% Extension (Lbs)	19,600	26,400	35,100	(kN)	87.2	117.4	156.

High tensile strength alloy bars shall be thermally stress relieved to produce a suitable metallurgical structure and shall be proof-tested individually during the process of manufacturing to a minimum of 90% of the manufacturer's minimum guaranteed ultimate strength. The mechanical properties of the completed bars shall be as follows:

	Regular Grade	Special Grade
Ultimate tensile strength (min.)	145,000 psi (1000MPa)	160,000 psi (1102MPa)
Yield strength, measured by the 0.7% extension under load method (min.)	130,000 psi (896MPa)	140,000 psi (965MPa)
Elongation in 20 bar diameters after rupture (% min.)	4.0	4.0
Reduction of area (% min.)	25	20
Cold deflection (Test Method No. Calif. 641) (min.)	2.0 inches (51 mm)	2.0 inches (51 mm)
Modulus of elasticity at 70% of the manufacturer's minimum guaranteed ultimate strength (min)	25 x 10 ⁶ psi (172.4GPa)	25 x 10 ⁶ psi (172.4GPa)
Diameter tolerances shall conform to ASTM A 29		

Bars of different ultimate strengths shall not be used interchangeably in the same member, unless otherwise permitted by the Engineer

In handling and shipping bars, care shall be taken to avoid bending, injury from deflection, scraping, or over stressing of the bars. All damaged bars will be rejected. When bars are to be extended by the use of couplers, the assembled units shall have a tensile strength of not less than the specified minimum ultimate tensile strength. Failure of any one sample to meet this requirement will be cause for rejection of the heat of bars and lot of couplers. The location of couplers in the member shall be subject to approval by the Engineer.

201.3 JOINT MATERIALS

201.3.1 Premolded Joint Filler. Premolded joint filler material shall consist of remolded strips of a durable resilient material.

Unless otherwise specified, remolded joint filler shall be one of the following types:

Preformed Expansion Joint Filler (Bituminous Type) ASTM D 994
 Non-extruding and Resilient Filler (Bituminous Type) ASTM D 1751
 Non-extruding and Resilient Filler (Non-bituminous Type)

ASTM D 1752

Type I	Sponge Rubber
Type II	Cork
Type III	Self-Expanding Cork

201.3.2 Wood Fillers. Boards shall be clear heart redwood, clear all heart red cedar, white pine, white spruce, sugar pine, western hemlock or white fir. All species other than redwood or cedar shall be treated with preservatives.

Wood preservative treatment shall be a pressure applied solution of copper chrome arsenate type wood preservative in accordance with Fed. Spec. TT-VV-550 Type II and ASPA P-5. Each piece shall bear mark identifying treatment.

201.3.3 Sealants. The joint sealers shall conform to Section 201.3.3.7 Elastomeric Polymer. Other joint sealants may be used only with the written authorization of the City Engineer and in conformance with the following specifications and/or manufacturer's recommendations. Joint surfaces must be clean, dry, and free of any loose matter.

201.3.3.1 Asphalt-Mineral. Asphalt mineral filler shall be homogeneous and shall be composed of asphalt and mineral filler. The asphalt shall be free from impurities. The asphalt mineral filler shall conform to the following requirements:

	<u>AASHTO</u>		
	<u>Test Method</u>	<u>Min.</u>	<u>Max</u>
Softening Pt.°F	T 53	125	145
Penetration at 32°F 200 g, 60 sec.	T 49	14	-
Penetration at 77°F 100 g, 5 sec.	T 49	50	70
Ductility at 77°F, cm	T 51	15	-
Asphalt Solubility, %	T 44	45	55
Mineral Filler, %	T 44	45	55
Water, %	T 55	-	2

201.3.3.2 Asphalt-Rubber. Rubber-asphalt sealant shall be hot pour, elastic type conforming to requirements of ASTM D 1190.

201.3.3.3 Polyurethane Polymer. Polyurethane component, job site mixed, self leveling urethane compound conforming to Fed Spec. TT-S-00227 Type I, class A, service temperature range - 40°F to 180°F.

201.3.3.4 PVC Extended Coal Tar. Shall be an approved single component polymer type elastomeric compound conforming to AASHTO T187.

201.3.3.5 Primer-Sealer. A liquid sealer, if required, shall be quick drying, non-staining of a type recommended by sealant manufacturer for type of substrate to which it is to be applied.

201.3.3.6 Sealant Backer. Backer rods shall be remolded polyurethane foam or butyl rubber foam or neoprene foam in size to fit condition.

201.3.3.7 Elastomeric Polymer. This elastomeric asphalt sealant is a two-component, cold-applied formulation of asphalt and urethane. Mixing of the components shall be in accordance with the manufacturer's recommendations.

The joint sealant must meet ASTM-D-1850 entitled Concrete Joint Sealer, Cold Application Type, Single, or Multiple Component.

201.4 CONCRETE CURING COMPOUND

201.4.1 General. Curing compound shall consist of a liquid which, when applied to fresh concrete by means of a spray gun, will form an impervious membrane over the exposed surfaces of the concrete.

The membrane may be either asphaltic or paraffin derivatives to which other water-proofing materials may have been added. Concrete curing compounds shall be designated by type as follows:

Type 1 - Clear or translucent with red fugitive dye

Type 2 - White pigmented

Type 3 - Light gray pigmented

Type 4 - Black pigmented

All compounds shall be furnished by the contractor and shall be delivered ready-mixed in sealed original containers bearing the manufacturer's name and product identification. At the time of use, pigmented curing compounds shall be thoroughly mixed, with the pigment uniformly dispersed throughout the mixture.

The rate of application shall be such that the compound forms a continuous, unbroken film when applied to the work. The Engineer will determine the permissible rate of coverage of a curing compound.

Unless otherwise specified, Type I curing compound shall be used.

201.4.2 Test Requirements. Curing compounds shall be tested in accordance with ASTM C 309.

201.5 CEMENT MORTAR

201.5.1 General. Cement mortar shall consist of a mixture of portland cement, sand and water. Cement and sand shall first be combined in the proper proportions and then thoroughly mixed with the required amount of water.

Cement mortar shall be designated by class and proportioned by loose volume as follows:

<u>Designation</u>	<u>Proportions</u>
Class "A" mortar	1 part cement to 1 part sand
Class "B" mortar	1 part cement to 1½ parts sand
Class "C" mortar	1 part cement to 2 parts sand
Class "D" mortar	1 part cement to 2½ parts sand
Class "E" mortar	1 part cement to 3 parts sand
Class "F" mortar	1 part cement to 3½ parts sand

The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended.

Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be permitted.

201.5.2 Cement. Cement shall conform to the requirements of Subsection 201.1.2.

201.5.3 Sand. Sand shall conform to the requirements of Subsection 200.1.5. In proportioning the sand it shall be measured loose (without shaking or compacting) in measuring boxes or other suitable containers of known capacity.

201.5.4 Water. Water shall conform to the requirements of Subsection 201.1.4.

201.5.5 Admixtures. No admixture shall be used in mortar unless otherwise specified or approved by the Engineer.

201.5.6 Quick setting grout shall be a high strength, non-staining grout approved by the Engineer prior to use. It shall reach an initial set within 90 minutes at 70° F (21°C) and shall reach a minimum compressive strength of 2500 psi (19.2 MPa) within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's instructions.

201.6 HYDRATED LIME. Hydrated lime for use in soil stabilization and conditioning shall conform to the requirements of ASTM C 207 Type N except the calcium oxide and magnesium oxide shall be a minimum of 90% on non-volatile basis. Hydrated lime shall have a maximum free moisture content of 1-1/2%.

Sampling and testing, when required by the Engineer, shall be done in accordance with ASTM C 25 and C 110.

SECTION 202

MASONRY MATERIALS

202.1 BRICK

202.1.1 Manhole Brick. Sewer manhole brick will conform to the requirements of AASHTO M-91, Grade MM with the following exceptions:

- (1) The average compressive strength of five bricks will be not less than 4000 psi (28 MPa), and the compressive strength of any individual brick will be not less than 3500 psi (24 MPa).
- (2) The absorption of any individual brick will be not more than 16% when submersed 24 hours in cold water.
- (3) Brick will conform to the following dimensions:

	<u>Depth Inches (mm)</u>	<u>Width Inches (mm)</u>	<u>Width Inches (mm)</u>
Standard Size	2 1/2 (63.5)	3 7/8 (98.4)	8 1/4 (209.6)
Allowable Variation	± 1/4 (6.4)	± 3/8 (9.5)	± 1/2 (12.7)

202.1.2 Building Brick. Building brick shall conform to the requirements of AASHTO M 114, Grade SW. The size and texture will be as specified on the plans or as approved by the Engineer.

202.1.3 Face Brick. Face brick will conform to the requirements of AASHTO M 114, Grade SW. The size, color, and texture will be as specified on the drawings or as approved by the Engineer.

202.1.4 Mortar, Grout, and Plaster

202.1.4.1 Mortar. Mortar used in brick construction will be Class "E," as specified in Subsection 201.5 to which 1/4 to 1/2 part lime putty has been added.

202.1.4.2 Grout. For use in spaces less than 2 inches (51 mm) clear in any dimension, grout will be one part Portland cement to three parts sand to which 1/10 part lime may be added. For spaces 2 inches (51 mm) or larger in all horizontal directions, grout will consist of one part Portland cement, three parts sand and two parts No. 4 concrete aggregate to which 1/10 part lime putty may be added.

202.1.4.3 Plaster. Plaster (back-parging) for brick sewer structures will be Class "E" mortar as specified in Subsection 201.5.

202.2 CONCRETE MASONRY UNITS

202.2.1 Masonry Units. Masonry units will be made with sand-gravel aggregate and will conform to ASTM C 90 for Grade N-II units. The net size of units will be as indicated on the Drawings. Unless otherwise specified, all units will be of the normal weight classification (oven-dry weight of concrete 125 lb/ft³ or more). Lightweight aggregates for use in concrete masonry units will be manufactured from expanded clay, expanded shale, scoria, pumice or a combination thereof, and shall conform to ASTM C 331.

202.2.2 Mortar, Grout, and Water.

- (1) Mortar. Mortar used in concrete block construction will be of Class "F" as specified in Subsection 201.5 to which 1/4 to 1/2 part lime putty has been added.
- (2) Grout. For use in spaces less than 4 inches (102 mm) clear in any dimension, grout will be 1 part Portland cement to 3 parts sand. For spaces 4 inches (102 mm) or larger in all horizontal directions, grout will consist of 1 part Portland cement, 2 Parts sand, and 2 parts No. 4 aggregate.
- (3) Water. Water will conform to the requirements of Subsection 201.1.4. The quantity of water to be used in the preparation of the mortar or grout will be the minimum required to produce a mixture sufficiently workable for the purpose intended.

SECTION 203

SOIL AND GRASSES

203.1 TOPSOIL. This specification describes Top Soil, soil used where the primary concern is the support of plant life. Top soil maybe loam or sandy loam containing organic material, and will be reasonably free of rocks, clay balls, roots, weeds, trash and other debris. Top soil will be obtained from the upper layer of ground in fields, creek banks, woods or from other sources approved by the Engineer.

203.2 FERTILIZER.

203.2.1 General. Fertilizer, as described in this section, shall be commercial type, granulated or pelletized and will be furnished in suitable containers. All fertilizer will conform to the conditions of the commercial fertilizer law of 1948 (Act Number 93) issued by the Louisiana Department of Agriculture.

203.2.2 Composition. Fertilizer will be commercial 8-8-8 which will contain a minimum of the following components by weight: 8% Nitrogen (N); 8% available Phosphoric Acid (P_2O_5); 8% soluble Potash (K_2O). Substitutes for commercial 8-8-8 with higher percentages of Nitrogen, available Phosphoric Acid, and soluble Potash in equal percentages by weight (up to 16-16-16) will be allowed in lieu of commercial 8-8-8 in proportionately smaller amounts based on the overall amounts of Nitrogen, available Phosphoric Acid, and soluble Potash. Fertilizers shall be analyzed for the minimum percentage by weight of the required components and an analysis submitted for batches of 2000 lbs. if required by the Engineer.

203.3 GRASSES.

203.3.1 Seed.

203.3.1.1 General. Seed, as defined in these specifications, will be grass seeds and will conform to all requirements, rules, and regulations of Chapter 11, Title 3 of Louisiana Revised Statutes of 1950.

203.3.1.2 Seed Mixture. The standard seed mixture will be 100% Hulled Bermuda and will have a coverage of approximately 30 pounds per acre. If field conditions warrant, other types of seed, such as rye grass, may be used with the permission of the Engineer.

203.3.1.3 Seed Analysis. Each variety of seed will be furnished and delivered in separate bags or other containers.

Each bag or container will bear an analysis tag which shall conform to the applicable requirements of the Rules and Regulations as promulgated by the Louisiana Seed Commission for enforcement of the Louisiana Seed Law (Acts 372 of 1956 and 1952.). The analysis tag will be a No. 6 standard shipping tag, minimum size, and will carry the information required by the Louisiana Seed Law, and in addition, will carry the laboratory number of the Louisiana Department of Agriculture for that particular lot number shown on the tag.

All seed furnished shall be of the previous season's crop and the date of the analysis shown on each tag shall be within six (6) months of the time of delivery to the project. The minimum percentage of pure live seed and the maximum percentage of weed permitted will be as follows:

<u>Variety of Seed</u>	<u>Minimum Percentage of Pure Live Seed</u>	<u>Maximum Percentage of Weed Seed</u>
Hulled Bermuda	86	1
Rye Grass	76	2

Undesirable weeds shall be interpreted to mean that list of weeds, except Bermuda, which has been approved and adopted by the Louisiana Seed Commission as being noxious in Louisiana.

203.3.2 Sod. Sod shall be field or nursery grown. Field Sod shall be strongly rooted grasses, not less than two years old, free of weeds, undesirable plants, stones and other material detrimental to development or maintenance of lawn. Nursery grown grass sod shall be Centipede, Tiffany Bermuda, Nomow Bermuda, Common Bermuda, or St. Augustine. Slab sod shall be cut with approved sod cutters. The designated area shall be mowed when necessary. Sod shall be cut to a minimum soil depth of 1 1/2 inches (40 mm) for field grown grass and 1 inch (25 mm) for nursery grown grass, and to a uniform width and in convenient lengths for handling. Soil shall be retained on roots of sod during excavating, hauling and planting.

203.4 MULCH: Mulching material shall be used for erosion control on areas that have been seeded as indicated on drawings.

203.4.1 Vegetable Mulch. Mulch shall be vegetative in character and shall consist of either stems or stalks of oats, rye, wheat or other approved straws. The contractor may also use hay obtained from various legumes and grasses such as lespedezas, clover, vetches, soybeans, bermuda, Dallis, carpet sedge, fescue or any combination thereof. Straw or hay shall be reasonably dry and free from mold, Johnson grass or other noxious weeds.

203.4.2 Asphalt Mulch. Asphalt mulch shall be an approved emulsified asphalt conforming to Subsection 204.3.

203.4.3 Wood Cellulose Fiber (Hydro-Mulch). Wood cellulose fiber for use with hydraulic application of grass seed and fertilizer shall consist of specially prepared wood cellulose fiber, processed to contain no growth or germination-inhibiting factors and dyed on appropriate color to facilitate visual metering of the application of materials. On an air-dry weight basis, the wood cellulose fiber shall contain a maximum of 12% moisture, plus or minus three percent at the time of manufacture. The pH range shall be from 3.5 to 5.0. The wood cellulose fiber will be manufactured so that:

203.4.3.1 After addition and agitation in slurry tanks with fertilizers, grass seeds, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry.

203.4.3.2 When hydraulically sprayed on the ground, the material will form a blotter like cover impregnated uniformly with grass seed.

203.4.3.3 The cover will allow the absorption of moisture and allow rainfall or applied water to percolate to the underlying soil.

203.5 MATTING. Matting shall be of jute composition of uniform open-weaved new unbleached, single jute yarn. Yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Jute matting shall be furnished in roll strips and shall conform to the following specifications:

Length - approximately 75 (68 m) yards

Width - 48" (122 cm) plus or minus one inch

78 warp ends per width

41 weft ends per linear yard (.914 m)

Weight to average 1.22 pounds (.54 kg) per linear yard, + 5%

Staples used with jute matting shall be "u" shaped number 11 gauge or heavier wire. They shall be 6 inches (15.2 cm) long and 1 (2.54 cm) to 10 inches wide. Handmade staples shall be made from 12 inch (31 cm) long number 8 gauge or heavier wire.

203.6 FIBER GLASS ROVING.

203.6.1 Description. This specification covers a continuous fiber glass roving used in combination with asphalt or other cementitious materials to control erosion on newly seeded slopes and drainage channels.

203.6.2 General Requirements. The material shall be formed from continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound, collected into strands and lightly bound together into roving with the use of clay, starch or like deleterious substances. The roving shall be wound into a cylindrical package approximately one ft. (.3 m) high in such a manner that the roving can be continuously fed from the center of the package through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

203.6.3 Detailed Requirements. The fiber glass roving shall conform to the following requirements as per ASTM D-578:

<u>PROPERTY</u>	<u>ALTERNATE</u>	<u>LIMITS</u>
Strands/Rove	28-32	56-64
Fibers/Strand	368-468	184-284
Fiber Dia., (in.) (G) (cm)	.00035-.0004 (.00089) - (.0010)	.00035-.0004 (.00089)-(.0010)
Yards/lb. of Strand	6,500-7,000	13,000-14,000
Yards/lb. of Rove Organic content, Percent Max.	.75	.45
Package Wt., lbs. (kg)	28-37 (12.7-16.78)	28-37 (12.7-16.78)

SECTION 204

BITUMINOUS MATERIALS

204.1 ASPHALT CEMENT.

204.1.1 General. Asphalt cement shall be uncracked petroleum asphalt, steam, vacuum or solvent refined. The Asphalt shall be produced from asphaltic or semi-asphaltic base crude petroleum. It shall be free from admixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffin oil and shall be homogeneous and free from water and shall not foam when heated to 350 degrees F. (177°C).

Asphalt cement shall not be heated during the process of its manufacture, storage, or during construction so as to cause injury as evidence by the formation of carbonized particles. At no time shall the temperature in storage be higher than 10 degrees F (5.5°C) below the actual flash point of the asphalt.

204.1.2 Testing Requirements. Asphalt cement shall be classified by penetration and shall conform to the requirements set forth in the following table:

Specification Designation	AASHTO Test Method	AC-20	AC-40	AC-5	AC-10
Flash Point (Open Cup) Degrees F, (C) Min.	T 48	450 (232)	450 (282)	350 (177)	425 (218)
Penetration at 77° F (25 C), 100g, 5 sec.	T 49	60-70	40-50	130-150	80-90
Viscosity, 275° F (135°C) poises	T201	300	400	175	250
Viscosity, 140°F (60°C) poises	T202	2000±4000	4000± 800	500±100	1000±200
Solubility in Trichloroethylene, %	T 44	99	99	99	99
Tests on Residue from Thin Film., Oven Test					
Viscosity, 140° F (60°C) poises	T202	8000-	16,000-	2000	4000
Ductility, 77°F (25°C) 5cm.	T 51	100±	100±	100±	100±
Spot Test (Standard Naptha Solvent)	T102	Neg	Neg	Neg	Neg

204.1.3 Test Report and Certification. At the time of delivery of each shipment of asphalt, the vendor supplying the materials shall deliver to the purchaser certified copies of the test report which shall indicate the name of the vendor, type and grade of asphalt delivered, date and point of delivery, quantity delivered, delivery ticket number, purchase order number, and results of the above-specified tests. The test report shall be certified and signed by an authorized representative of the vendor that the product delivered conforms to the specifications for the type and grade indicated.

Until the certified test reports and samples of the material have been checked by the Engineer to determine their conformity with the prescribed requirements, the material to which such report relates and any work in which it may have been incorporated as an integral component will be only tentatively accepted by the Contracting Agency. Final acceptance will be dependent upon the determination of the Engineer that the material involved fulfills the requirements prescribed therefore. The certified test reports and the testing required in connection with the reports shall be free of expense to the Contracting Agency.

204.1.4 Temperatures. Unless otherwise specified in these specifications, the various grades of asphalt cement shall be applied at a temperature range as indicated in the following table, the exact temperature to be determined by the Engineer. At no time after loading into a tank car or truck for transportation from the refinery to the purchaser, shall the temperature of the asphalt cement be raised to within 10 F (5.5° C) of the flash point.

Asphalt cement shall be heated in such a manner that steam or hot oils will not be introduced directly into the asphalt cement during heating. The Contractor shall furnish and keep on the site, at all times, an accurate thermometer suitable for determining the temperature of the asphalt cement.

204.1.5 Distributing Equipment. Distributing equipment shall meet the requirements of Subsection 204.2.5.

204.2 CUTBACK ASPHALT.

204.2.1 General. Cutback asphalt shall consist essentially of uncracked petroleum asphalt base stock and shall conform to the following classifications:

204.2.1.1 Medium-curing cutback asphalt, designated by the letters MC, shall consist of an uncracked petroleum base stock produced by the processing of asphaltic or semi-asphaltic base crude petroleum, blended with a kerosene-type solvent. The base stock for all MC materials shall be straight run asphalt produced within the penetration range of 100 to 300, and the end point of the kerosene-type solvent shall not exceed 525°F (274°C). Medium curing liquid cutback asphalt shall be free from water and show no separation.

204.2.1.2 Rapid-curing cutback asphalt, designated by the letters RC, shall consist of an uncracked petroleum asphalt base stock, produced by the process of asphaltic or semi-asphaltic base crude petroleum, blended with a naphtha or gasoline-type solvent. The base stock for all RC materials shall be straight run asphalt produced within the penetration range of 70-150. Rapid-curing cutback asphalt shall be free from water and show no separation.

The asphalt shall not be heated during the process of its manufacture or during construction so as to cause injury as evidenced by the formation of carbonized particles.

204.2.2 Test Requirements. Cutback asphalt shall consist of materials specified in the above classifications and shall conform to the requirements set forth in the following tables:

CUTBACK ASPHALT MEDIUM CURE

	Test Method	MC-30		MC-70		MC-250	
		Min.	Max.	Min.	Max.	Min.	Max.
Flash Point Open Tag, °F (°C)	AASHTO T 79	100 (38)	----	100 (38)	----	150 (66)	----
Viscosity, Saybolt-Furol at 77°F (25°C), sec	AASHTO T 72	75	150	----	----	----	----
at 140°F (60°C), sec		----	----	35	70	125	250
Distillation test, distillate percentage by volume of total distillate to 680°F; (360°C)	AASHTO T 78						
to 374°F (190°C)		----	----	----	----	----	----
to 437°F (225°C)		----	25	----	20	----	10
to 500°F (260°C)		40	70	20	60	15	55
to 600°F (316°C)		75	93	65	90	60	87
Residue from distillation to 680°F (360°C); percentage volume by difference 50		50	----	55	----	67	----
Tests on Residue:							
Penetration at 77°F (25°C) 100g., 5 sec.	AASHTO T 49	120	250	120	250	120	250
Ductility at 77°F, for residues to 200 pen.: 5 cm/min.	AASHTO T 51	100	----	100	----	100	----
Ductility at 77°F (25°C), 5 cm/min.	AASHTO T 51	----	----	----	----	----	----
Ductility at 60°F (15.5°C) for residues of 200-300 pen., 5 cm/min.	AASHTO T 51	100	----	100	----	100	----
Solubility in Trichloroethylene	AASHTO T 44	99.0	----	99.0	----	99.0	----

CUTBACK ASPHALT RAPID CURE

		MC-30		MC-70		MC-250	
Test Method		Min.	Max.	Min.	Max.	Min.	Max.
Flash Point Open Tag, °F (°C)	AASHTO T 79	----	----	80 (27)	----	80 (27)	----
Viscosity, Saybolt-Furol at 77°F (25°C), sec at 140°F (60°C), sec	AASHTO T 72	----	----	----	----	----	----
		35	70	125	250	400	800
Distillation test, distillate percentage by volume of total distillate to 680°F; (360°C)	AASHTO T 7						
to 374°F (190°C)		10	----	----	----	----	----
to 437°F (225°C)		50	----	35	----	15	----
to 500°F (260°C)		70	----	60	----	45	----
to 600°F (316°C)		85	----	80	----	75	----
Residue from distillation to 680°F (360°C); percentage volume by difference 50		55	----	65	----	75	----
Tests on Residue:							
Penetration at 77°F (25°C) 100g., 5 sec.	AASHTO T 49	80	120	80	120	80	120
Ductility at 77°F, for residues to 200 pen.: 5 cm/min.	AASHTO T 51	----	----	----	----	----	----
Ductility at 77°F (25°C), 5 cm/min.	AASHTO T 51	100	----	100	----	100	----
Ductility at 60°F (15.5°C) for residues of 200-300 pen., 5 cm/min.	AASHTO T 51	----	----	----	----	----	----
Solubility in Trichloroethylene	AASHTO T 44	99.0	----	99.0	----	99.0	----

204.2.3 Test Reports and Certifications. Test reports and certifications will be furnished in accordance with Section 204.1.3.

204.2.3 Temperatures. Unless authorized by the Engineer, no cutback asphalt shall be spread when the air temperature is lower than 50° F. At 50°F the atmospheric temperature must be rising.

Unless otherwise specified in these specifications, the various grades of cutback asphalt shall be applied at temperatures within the limits specified in the table of application temperatures below the exact temperature to be determined by the Engineer.

At no time after loading into a tank car or truck for transportation from the refinery to the purchaser, unless authorized by the Engineer, shall the temperature of the cutback asphalt be higher than 10°F (5.5°C) below the actual flash point.

Cutback asphalt shall be heated in such a manner that steam or hot oils will not be introduced directly into the liquid asphalt during heating. The Contractor shall furnish and keep on the site, at all times, an accurate thermometer suitable for determining the temperature of the liquid asphalt.

204.2.5 Distributing Equipment. Distributor trucks shall be of the pressure type with insulated tanks. Spray bars shall have a minimum length of 9 feet (2.75 m) and shall be of the full-circulating type. The spray bar shall be adjustable to permit varying height above the surface to be treated. The nozzles attached to the bar shall be either of the conical or flat clotted type.

The distance center to center of the nozzles shall not exceed 6 inches (14.4 cm). The valves shall be operated by levers so that one or all valves may be quickly opened or closed in one operation. The valves which control the flow from nozzles shall be of a positive acting design so as to provide a uniform unbroken spread of bituminous material on the surface. The distributor shall be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of bituminous material being applied and with tachometer of the auxiliary wheel type reading speed in feet per minute. The spreading equipment shall be so designed and articulated that uniform application of a bituminous material, in controlled amounts, may be made ranging from .02 to 1.0 gallon per square yard (.09 to 4.5 liters per sq. meter) of surface and with a range of pressure from 25 to 75 pounds per square inch (172 to 517 k Pa).

If a spray bar extension is used to cover a greater width, it shall be of the full-circulating type. The distributor shall be equipped with a hose and nozzle attachment to be used for spotting skipped areas and areas inaccessible to the distributor. The distributor shall also be equipped with pressure gauges and an accurate thermometer for determination of the temperature of bituminous material. Distributors and booster tanks shall be so maintained at all times as to prevent dripping of free bituminous material from any part of the equipment.

The Engineer reserves the right to order the discontinuance of use of equipment which in his opinion, fails to produce a satisfactory distribution of asphalt in accordance with specifications.

204.3 EMULSIFIED ASPHALT

204.3.1 General. Emulsified asphalt shall be composed of a paving asphalt base uniformly emulsified with water and an emulsifying or stabilizing agent. They shall be homogeneous throughout and if stored, shall show no separation of ingredients within 30 days after delivery. Emulsified asphalt shall be classified as rapid-setting or slow-setting type in either anionic or cationic emulsions.

- (1) Penetration type and high viscosity type emulsions shall be designated by the letters RS (rapid setting).
- (2) Mixing type emulsion shall be designated by the letters SS (slow setting).

ANIONIC EMULSIONS

Test Description	AASHTO Test Method No.	SLOW SETTING			
		SS-I		SS-I h	
		Min.	Max.	Min.	Max.
Furol Viscosity at 77 F (25°C), sec.	T 59	20	100	20	100
Settlement, 5 days, % (a)	T 59		5		5
Storage Stability 1 day (b)	T 59		1		1
Sieve Test (Retained on No. 20), %	T 59		0.10		0.10
Cement Mixing Test, %	T 59		2.0		2.0
Residue from distillation,%	T 59	57		57	
Penetration of residue at 77°F (25°C)	T 59	100	200	40	90
Solubility of residue,% in Trichloroethylene	T 59	97.5		97.5	
Ductility of residue at 77°F (25°C). 5 cm/min	T 59	40		40	

CATONIC EMULSIONS

Test Description	AASHTO Test No.	RAPID SETTING (d) CRS-2		MEDIUM SETTING CMS-2		COS-1h		SLOW SETTING CSS-1h	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
						20	100	20	100
Furol Viscosity at 77°F (25°C), sec.	T 59								
Furol Viscosity at 122°F (50°C), sec.	T 59	100	400	50	450				
Settlement, 5 days, % (a)	T 59		5		5		5		5
Storage Stability Test 1 day (b)	T 59		1		1		1		1
Demulsibility 35 ml. 0.8% sodium dioctyl sulfosuccinate, %(c)	T 59	40							
Sieve Test (Retained on No. 20), %	T 59		0.10		0.10		0.10		0.10
Particle Charge Test		Positive		Positive		Positive (a)		Positive (a)	
Cement Mixing Test, %	D 244						2.0		2.0
Oil distillate by vol. of emulsion %	T 59		3		12				
Residue from distillation, %	T 49	65		65			57		57
Penetration of residue at 77°F (25°C)	T 49	100	250	100	250	40	90	40	90
Solubility of residue, % in Trichloroethylene Ductility of residue 77° (25°C), 5 cm/min	D 2042 D 113	97.5 40		97.5 40		97.5 40		97.5 40	

- (a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days time; or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than 5 days.
- (b) The 24-hour (1 day) storage stability test may be used instead of the 5 day settlement test.
- (c) The demulsibility test shall be made within 30 days from the date of shipment.
- (d) A harder base asphalt meeting current paving asphalt specifications may be specified with the provision that the test requirements on the Residue from Distillation be waived.
- (e) Must meet a pH requirement of 6.7 maximum (ASTM E.70) if the Particle Charge Test result is inconclusive.

The slow setting type emulsion shall conform to the following adhesion test:

Sixty grams of dry crushed rock shall be placed in an 8 ounce (235ml) seamless ointment tin, moistened with distilled water and then vigorously mixed with 10 grams of emulsified asphalt for not less than 3 minutes or until the aggregate is completely coated. The aggregate and emulsified asphalt shall be at room temperature at the time of mixing. After coating, the mixture shall be transferred to a Petri dish and placed in a constant temperature oven maintained at 140°F (60°C) for a period of 16 to 18 hours. At the end of this period, the dish and sample shall be removed from the oven and cooled to room temperature for one hour. The dish and sample shall then be immersed in distilled water maintained at 140° F (60° C) for one hour. While still in the water bath, using a shaded 70 watt lamp, the sample shall be examined for stripping. Thin translucent areas are considered completely coated. Exposed portions or edges are considered stripped. When emulsified asphalt is tested by this method 100% of all aggregate surfaces shall remain coated.

204.3.3 Test Reports and Certification. Test reports and certifications shall be made in accordance with Subsection 204.1.3.

204.3.4 Temperatures. Emulsified asphalt may be reheated, but at no time after loading for transportation from the refinery to the purchaser shall the temperature of the emulsion be raised above 160°F (71°C). During reheating, the emulsified asphalt shall be permitted to cool to a temperature of less than 40°F (4°C).

Emulsified asphalt shall be heated in such a manner that no steam or hot oils will be introduced into the asphalt. The contractor shall furnish and keep on the site an accurate thermometer suitable for determining the temperature of the emulsified asphalt.

204.2.2 Distributing Equipment. Distributing equipment shall be the same as specified in Subsection 204.2.5 except that hand spraying by means of hose or bar through a gear pump or air tank will be acceptable for applications to 0.10 gal. per square yard (.45 liters per square meter) for flat work or tacking of vertical edges. Uniform coverage will be required.

204.4 UNDERSEALING ASPHALT.

204.4.1 General. Undersealing asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not foam when heated to 350°F (177°C). All storage tanks, piping, retorts, booster tanks, distributors and other equipment used in delivering, storing or handling asphalt cement shall be kept clean and in good operating condition at all times and shall be operated in such a manner as to avoid any possible contamination of the contents with foreign materials.

204.4.2 Testing Requirements. Undersealing asphalt shall meet the requirements contained in the following table. All testing of undersealing asphalt, unless otherwise directed, shall be in accordance with the test methods given in the table.

	Test Method
Softening Point (Ring & Ball), °F (°C)	AASHTO 53 180 to 200° (82-93)
Penetration of Original Sample:	
At 32°F (0°C), 200g., 60 sec.	AASHTO 49 5+
At 77°F (25°C), 100g., 5 sec.	AASHTO 49 15 to 30
At 115°F (46°C), 50g., 5 sec	AASHTO 49 60-
Ductility at 77°F (25°C), 5 cm/min.	AASHTO 51 2+
Flash Point (Cleveland Open Cup) °F (°C)	AASHTO 48 425+ (218)
Solubility CCl ₄ %	AASHTO 44 99.0
Loss at 325°F (163°C), 5 hrs., %	AASHTO 47 5-
Penetration of residue % of original	AASHTO 49 70+

204.5 ASPHALTIC CONCRETE

204.5.1 General. These specifications are applicable to asphaltic concrete wearing, binder and base course mixtures of the plant mix type or a combination of these courses, each consisting of a mixture of mineral aggregate and asphalt cement with additives as required.

The type of mixture furnished shall be as indicated on the Drawings or if more than one type is indicated, whichever type the contractor elects, but in any event shall be one of the following types:

204.5.1.1 Type 1 mix shall be composed of the following:

- (a) Wearing Course: Crushed gravel, crushed slag, crushed stone or a combination of these materials, sand, mineral filler and asphalt cement.
- (b) Binder Course: Crushed gravel, crushed stone, crushed slag, or a combination of these materials, sand, mineral filler and asphalt cement.

204.5.1.2 Type 3 mix.

- (a) Wearing Course: Crushed gravel, crushed slag, crushed stone combined with crushed gravel, slag, stone or other approved types of screening, sand, mineral filler and asphalt cement.
- (b) Binder Course: Crushed gravel, crushed slag, crushed stone, or a combination of these materials, sand, mineral filler, and asphalt cement.

204.5.1.3 Type 4 mix shall be composed of expanded clay aggregate, sand, mineral filler and asphalt cement.

204.2.2.1 Type 5 mix - Base Course:

- (a) Mix 5A shall be composed of gravel, slag, stone, or expanded clay; sand; mineral filler (when needed); and asphalt cement.
- (b) Mix 5B shall be composed of gravel, slag, stone, expanded clay; sand, and asphalt cement; or pit run sand clay gravel and asphalt cement.

The thickness of courses shall be in approximate conformity with the plan typical sections unless otherwise specified. If the contract provides for both binder and wearing courses, the contractor will be permitted, at his option, to substitute wearing course material for binder course material at no change in unit price. Should the contractor elect to make such substitution, the mixture will be laid in layers of such thickness that the compaction and surface requirements are met. No substitutions are allowed for Type 5 mixture without the written approval of the engineer. The mineral aggregate and asphalt cement shall be combined in such proportions that the mixture shall meet the following requirements by weight:

MIX	ASPHALT CEMENT PERCENT	AGGREGATE PERCENT	PERCENT CRUSHED RET. ON #4	PERCENT FILLER MINIMUM (1)
Type 1:				
WC	4.5 to 7.0	93.0 to 95.5	75 Min.	3
BC	3.8 to 7.0	93.0 to 96.2	60 Min.	2
Type 3:				
WC	4.5 to 7.0	93.0 to 95.5	80 Min.	2
BC	3.8 to 7.0	93.0 to 96.2	60 Min.	2
Type 4:				
WC & BC	6.0 to 8.5	91.5		2
Type 5:				
Base Courses				
(A)	3.5 to 8.5	91.5 to 96.5	As needed	As needed
(B)	3.5 to 8.5	91.5 to 96.5		

(1) When hydrated lime is used as filler only 1/2 as much will be required. When crushed stone aggregate is used, mineral filler may be reduced or eliminated with prior approval from the engineer.

A description of the various mixtures is given in Table II of this Section.

204.5.2 Materials.

204.5.2.1 Asphaltic Cement shall conform to Subsection 204.1, grade AC-40. A silicone additive shall be dispersed in the asphalt by methods and in concentrations as approved by the Engineer. An anti-stripping additive, added at the approximate rate of 0.5 percent by weight of the asphalt cement, shall be thoroughly mixed with the asphalt cement at the plant. The anti-stripping additive must be approved by the Engineer prior to use. The anti-stripping additive shall be dispersed by either (1) measuring into the transport or into the asphalt feed line between the transport and storage tank or (2) through pump one time prior to use. When crushed limestone or expanded clay is used as aggregate, anti-stripping additive will not be required.

204.5.2.2 Aggregates. Aggregate shall conform to Subsection 200.6, type one, three or four mixtures.

204.5.2.3 Filler. Mineral filler shall conform to Subsection 200.6.5.

204.5.3 Design and Quality Control of Mixtures

204.5.3.1 General. The contractor shall assume full responsibility for the design and quality control of the mixtures. He shall design the mixture in accordance with the physical properties contained in Table II of this Section. He shall assume responsibility for the initial determination and all necessary subsequent adjustments in proportioning of materials used to produce the specified job mix and other physical characteristics.

204.5.3.2 Job Mix Formula. No work shall be started nor any mixture accepted until the contractor has submitted, in writing for approval, his job mix formula for the mixture he proposes to furnish. The formula so submitted shall indicate a single definite percentage of aggregate passing each required sieve size, a single percentage of asphalt cement, a single temperature at which the mixture is to be produced, the wet and dry mixing time when pugmill mixing is used, and the amount and types of additives to be used.

Mixing shall be accomplished in a manner that will give a minimum coating of 95 percent of the course aggregate particles when tested in accordance with AASHTO Designation: T 195. The asphalt content and extracted gradation shall be within type tolerances applied to the job mix formula initially submitted by the contractor.

Individual materials from more than one source shall not be used alternately nor mixed when used in surface courses without the written consent of the engineer. Where additional sources of materials are submitted to the engineer for approval as described in the preceding paragraph, a job mix formula shall be established and approved before the new material is used. When unsatisfactory results or other conditions make it necessary, the contractor may be required to establish a new job mix formula.

204.5.4 Plant Equipment. Asphaltic concrete shall be mixed at a central mixing plant by either batch, continuous or dryer-drum mixing process at the option of the contractor. The aggregates and asphalt may be proportioned either by weight or volume. All plants used shall conform to the requirements given in the succeeding paragraphs.

204.5.4.1 General Requirements. The following requirements apply to all types of plants unless otherwise specified:

- (a) **Asphalt Preparation Equipment:** The asphalt working tank shall be capable of uniformly heating the material, under positive control, to the required temperature. Heating shall be accomplished by approved means. The circulating system for asphalt cement shall be of adequate size to insure proper and continuous circulation during the entire operating period. All pipelines and fittings shall be heated or insulated. Tank capacity shall be sufficient for satisfactory plant operation. In addition to working tanks the contractor shall provide adequate storage tanks for asphalt.
- (b) **Cold Aggregate Feeder:** The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the dryer. The feeders shall be capable of delivering the maximum number of aggregate sizes required in their proper proportion. When more than one cold feeder is used, each shall operate as a separate unit, and the individual controls shall be integrated with a total master control.

In cases where the contractor elects to use either a dryer-drum process or screenless plant operation, the cold feed system will be such that it will control proportioning of aggregates accurate enough to produce a gradation consistently within the job mix formula. An automatic plant shut-off shall be provided to operate when any aggregate bin becomes empty or flow is interrupted.

- (c) **Dryer:** The plant shall include one or more dryers that will continuously agitate the aggregates during the heating and drying process. The equipment shall be capable of heating and drying all aggregates specified in the necessary quantities to supply the mixing unit continuously at its operating capacity and at a specified temperature and acceptable moisture content.
- (d) **Thermometers:** A thermometer shall be fixed in the asphalt feed line at an approved location near the discharge valve at the mixer unit except in dryer-drum plants where a recording thermometer shall be

located to indicate the temperature of the asphalt cement in storage. The plant shall also be equipped with an approved recording thermometer having an accuracy of $\pm 5^{\circ}\text{F}$ ($\pm 2.5^{\circ}\text{C}$) and a sensitivity which will provide an indication of temperature change at the rate of not less than 10°F (5°C) per minute. It shall be placed at the discharge chute of the dryer to register automatically the temperature of the heated material. The immediate repair or replacement of any defective or unsatisfactory instrument by some approved temperature recording apparatus will be required.

- (e) Dust Collector: The plant shall be provided with a dust collection system meeting all federal, state and local requirements.
- (f) Asphalt Measuring Equipment: Asphalt may be introduced either by weighing or volumetric measurement. When scales are used, they shall read to the nearest pound. In cases where the asphalt is measured by volumetric means, provisions shall be made to periodically check the quantity of asphalt delivered by weight and the quantity and the rate of asphalt delivered will be continuously displayed in digital form.

All asphalt measuring, regardless of the method used, shall be accurate to one percent of the quantity measured. For continuous and batch plants, the asphalt shall be sprayed in a manner which gives the most rapid and complete coating.

- (g) Mixer Unit: For batch and continuous methods of operation, the plant shall have an approved pugmill capable of producing a uniform mixture within the specified tolerances. For batch plants, the pugmill will be inspected by the engineer to determine its capacity. For continuous plants, the paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on the permanent gage.
- (h) For continuous and dryer-drum plants and when storage or surge bins are used with all other type plants, the contractor will furnish tuck-platform scales for the purpose of determining the pay weights for the mix. The scales shall be of sufficient length to weigh the entire unit transporting the mix and shall be the product of a reputable manufacturer and of a simple rugged design with the minimum number of adjustments consistent with the accuracy required, all as approved by the engineer. The scales shall be accurate to 0.5 percent of the loads applied. The contractor shall have the scales certified by a qualified independent scale service prior to their use and in the event there is cause to believe that the scales are performing incorrectly, he shall furnish additional certification

The scales shall be equipped with an approved automatic printer system which will print the tare weight as well as the total weight of the unit and the mix.

In lieu of platform scales the contractor may weigh the mixture in a weigh box located under the surge or storage bin prior to loading into a truck provided the scales meet the requirements given in the preceding paragraphs.

204.5.4.2 Batch Plants. When batch plants are used, the contractor, at his option, can use either gradation control by means of screens or cold feed control without separating the dried aggregate into two or more sizes. If cold feed control is selected, a scalping screen will be required. The details of equipment requirements for each mode of operation shall be as described herein and the general requirements given in Heading 204.5.4.1 of this subsection.

- (a) Screens: Plant screens capable of screening all aggregates to the sizes required for proportioning, and having normal capacity in excess of the full capacity of the mixer or the dryer, shall be provided. The contractor shall expose the screens for inspection at the request of the engineer.
- (b) Bins: The bin sizes shall be adequate for continuous operation of the plant at rated capacity. Bins shall be so arranged to insure separate and adequate storage of appropriate fractions of the aggregate. Adequate dry storage shall be provided for the mineral filler and provisions made for proportioning the filler for

each batch of mixture. Each hot bin shall be provided with an overflow pipe or chute (except the mineral filler bin) to prevent contamination of materials. Each size of aggregate, as required, shall be stored in separate bins when screens are used.

For screenless operation, aggregate shall be stored in one or more bins with adequate provisions to prevent segregation.

- (c) **Weigh Box or Hopper:** Equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales ample in size to hold a full batch. Gates on both bins and hopper shall be so constructed as to prevent leakage when they are closed.
- (d) **Plant Scales:** Scales for any weigh box or hopper shall be the springless dial type and shall be of a standard make and design, accurate to 0.5 percent of the indicated load. They shall be designed, constructed and installed in such a manner as to be reasonably free from vibration. All scales for weighing the asphalt shall have a capacity which will insure accuracy within the tolerance specified elsewhere herein. Scales shall be tested as often as deemed necessary to insure their accuracy as directed by the engineer.

The contractor shall also provide an approved printer system which will print separately the weight of the aggregate and of the asphalt.

- (e) **Control of Mixing Time:** The mixer shall have an approved timing device to prevent the entrance of additional material while the mixing operation is in progress, and the discharge gates shall be locked to insure proper mixing. The device shall also lock the asphalt bucket throughout the dry mixing period.

204.5.4.3 Continuous Mix Plants. When continuous plants are used, the contractor, at his option, can use either gradation control by means of screens or cold feed without separating the dried aggregate. If cold feed control is selected, a scalping screen will be required. The details of equipment requirements for continuous mix plants shall be as described herein and the general requirements given in Heading 204.5.4.1 of this subsection.

- (a) **Gradation Control Unit:** The plant shall include a means for accurately proportioning each size of aggregate by volumetric measurement. The unit shall include a feeder mounted under the bins with each bin compartment having an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from it. The orifice shall be rectangular, with one dimension adjustable by positive mechanical adjustment, and provided with a lock. Indicators shall be provided on each gate to show the gate opening in inches. If cold feed control is selected, one or more bins may be used for aggregate. Mineral filler, when specified, shall be proportioned separately from a hopper equipped with an adjustable feed which may be accurately and conveniently calibrated and which shall be interlocked with the aggregate and asphalt feeds.
- (b) **Weight Calibration of Aggregate Feed:** Samples shall be taken and weighed as a means of calibrating gate openings. Material shall be fed out of a bin through the individual orifice and bypassed to an approved test box. The material from each compartment shall be taken separately. The plant shall be equipped to handle conveniently such test samples weighing not less than 200 pounds (90 kg). An accurate platform scale shall be provided by the contractor to weigh the test samples.
- (c) **Synchronization of Aggregate and Asphalt Feed:** Satisfactory means shall be provided to assure positive interlocking control between the flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning device. This shall be accomplished by interlocking mechanical means or by any positive method approved by the engineer. The aggregate bins shall be provided with signal devices and controls which will warn of low levels and which will automatically stop the flow of all aggregate and asphalt to the mixer when the aggregate in any one bin is so low that the feeder will not operate at set capacity. The asphalt storage system will be provided with signal devices and controls which will warn of low levels of asphalt and which will automatically stop the entire plant operation when the asphalt storage level is lowered to the point of exposing the feed end of the asphalt suction line.

If mineral filler is specified, the plant will include separate equipment to accurately proportion the mineral filler sufficiently in advance of the addition of the asphalt to give a proper dry mix time. This equipment shall be of such design as to give a constant flow of the material and shall include a storage bin of sufficient capacity and an adjustable calibrated gate. The filler feed system shall be interlocked with the aggregate control system and feed the material by mechanical means. A gravity type feed will not be permitted. When dust collected in bag houses is allowed for mineral filler, it may be added into the stream of dried aggregate provided the proper proportions can be assured.

- (d) Control of Mixing Time: The plant shall be equipped with a positive means to govern the time of mixing. Mixing time shall not be altered unless approved by the engineer.
- (e) Discharge Box: The plant shall be equipped with either a discharge box of sufficient size to collect the mix as it comes out of the pugmill to prevent segregation, or a surge bin.

204.5.4.4 Dryer-drum Plants. The details of equipment requirements shall be as described herein and the general requirements given under Heading (a) of this subsection.

- (a) The complete dryer-drum process, including plant with necessary auxiliary equipment and controls, operating procedures, and testing and sampling methods during operation, must be approved by the Engineer prior to use. All new dryer-drum plants are required to demonstrate their ability to produce mixes that will meet specification requirements before placing final surface course.
- (b) The system shall provide positive weight control of the cold aggregate feed by use of a belt scale or other device which is automatically coupled with the asphalt flow and interlocked with the asphalt measuring system to maintain the required proportions. The weighing will be continuous and be accurate to 0.5 percent. Proportioning of the mixture shall be in accordance with the job mix formula and within the allowable tolerances for control of mixtures. The system shall be equipped with automatic burner controls and shall provide for temperature sensing of the mixture at discharge.

The cold aggregate bins shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation. Scalping screens shall be provided to insure removal of all objectionable material from the stockpiled materials prior to loading of the aggregates into the cold feed bins. An additional scalping screen will be required between the cold feed discharge and dryer in advance of the belt scale.

Provisions shall be made for introducing the moisture content of the cold feed aggregates into the belt weighing signal and correcting wet aggregate weight to dry aggregate weight. Dry or wet weight of the aggregate flow shall be displayed digitally in appropriate units of weight and time and totalized. The rate of flow of asphalt used will also be digitally displayed and totalized.

Means shall be provided for conveniently diverting aggregate delivery into trucks, front and loaders, or other containers for checking the accuracy of the aggregate delivery system.

- (c) The asphalt pump shall be a positive displacement type pump. The asphalt storage system shall be equipped with a device for automatic plant shut-off when the intake of the pump is not working under required pressure.

For mineral filler a separate bin and feeder shall be furnished with its drive interlocked with the aggregate feeders. Mineral filler shall be introduced directly into the drum by approved means.

When the automatic asphalt adjustments or any other critical control and shutoff devices are not functioning, the plant will not be permitted to operate.

TABLE I

	Control Limits	
	Individual	Average of 2 Tests
$\frac{3}{4}$ " (19 mm) and larger	±9	±6
$\frac{1}{2}$ " (12.7 mm)	±12	±9
$\frac{3}{8}$ " (9.5 mm)	±10	±7
No. 4	±10	±7
No. 10	±9	±6
No. 40	±7	±5
No. 80	±5	±4
No. 200	±3	±2
Percent Asphalt	±6	±4
Temperature of Mix °F (°C)*	±25 (±14)	±25 (±14)

Percent Crushed

Minimum Value as specified in Table V of this Section.

*As based on approved mixing temperature after discharge into the truck.

NOTE: When control limits as specified exceed the upper or lower limits for allowable gradations contained in Table II of this Section, the control limits are fixed at the same values as those required by the specification limits.

TABLE II**General Requirements for Asphaltic Concrete Mixtures****A. Grading Requirements (6)**

U. S. Sieve	Type I		Type 3	
	W.C.	B.C.	W.C. (I)	B.C.
1 ½" (38.1 mm)	-	-	-	-
1 ¼" (31.7 mm)	-	100	-	100
1" (25.4 mm)	100	90-100	100	90-100
¾" (19.0 mm)	85-100	75-100	85-100	75-100
½" (12.7 mm)	70-100	55-95	70-100	55-95
⅜" (9.5 mm)	-	-	-	-
No. 4	40-70	35-70	40-70	35-70
No. 10	25-55	20-50	25-55	20-50
No. 40	8-33	10-33	8-33	10-33
No. 80	4-20	5-20	4-20	5-20
No. 200	2-10	2-10	2-10	2-10
Asphalt %	4.5-7.0	3.8-7.0	4.5-7.0	3.8-7.0
Aggregate %	93.0-95.5	93.0-96.2	93.0-95.5	93.0-96.2
Mineral Filler % Min. (7)	8	2	2	2
% Crushed Ret. on No. 4	75 Min.	60 Min.	80 Min.	60 Min.
Asphalt Cement (3)	AC-40	AC-40	AC-40	AC-40
Course Agg. Types (4)	A, B, C	A, B, C, D	A, B, C	A, B, C, D

TABLE II - Continued**B. Minimum Acceptance Requirements**

U. S. Sieve	Type I		Type 3	
	W.C.	B.C.	W.C. (I)	B.C.
Marshall Stability (lbs.) (Kg) (Average of 4 tests)				
AC-20	1100 (399)	1100 (499)	-	-
AC-40	1200 (544)	1200 (544)	1700 (771)	1400 (635)
Density %	95	95	95	95
Linear % of Roadway Surf. Tol.				
1/8" (1.58 mm) (with Auto. Screed)	0.0 - 1.0	-	0.0 - 1.0	-
3/16" (4.76 mm) (without Auto. Screed)	0.0 - 0.5	-	0.0 - 0.5	-

Acceptable Deviation from Control Tolerances or Gradation Limits for Nos. 4, 40 & 80 Sieves: 2% for individuals, 1% for average of two tests.

TABLE II - Continued**General Requirements for Asphaltic Concrete Mixtures****A. Grading Requirements (6)**

U. S. Sieve	Type 4	Type 5	Mix Control Tolerance		
	W.C. & B.C.	Base (A)	Base (B) (2)	Ind.	Av. of 2
1 1/2" (38.1 mm)	-	100	100	± 9	± 6
1 1/4" (31.7 mm)	-		-	± 9	± 6
1" (25.4 mm)	-	80-100	80-100	± 9	± 6
3/4" (19.0 mm)	100	70-100	-	± 9	± 6
1/2" (12.7 mm)	80-100	55-85	-	± 12	± 9
3/8" (9.5 mm)	-	-	-	± 10	± 7
No. 4	55-85	35-60	35-75	± 10	± 7
No. 10	45-75	20-45	-	± 9	± 6
No. 40	20-55	10-30	10-55	± 7	± 5
No. 80	10-25	5-25	-	± 5	± 4
No. 200	2-12	2-10	2-15	± 3	± 2
Asphalt %	6.0-8.5	3.5-8.5	3.5-8.5	± .6	± .4
Aggregate %	91.5-94.0	91.5-96.5	91.5-96.5		
Mineral Filler % Min. (7)	2	As needed	-		
% Crushed Ret. on No. 4	-	As needed	-		
Asphalt Cement (3)	AC-40	AC-40	AC-20		
Course Agg. Types (4)	F	A, B, C, D, F	A, B, C, D, F		

TABLE II - Continued**B. Minimum Acceptance Requirements**

U. S. Sieve	Type 4	Type 5	Mix Control Tolerance		
	W.C. & B.C.	Base (A)	Base (B) (2)	Ind.	Av. of 2
AC-20	1100 (499)	1100 (499)	800 (363)		
AC-40	1200 (544)	1200 (544)	-		
Density %	95	95	94		
Linear % of Roadway Surf. Tol. 1/8" (1.58 mm) with Auto Screed)	.0-1.0	-	-	-	
3/16" (4.76 mm) (without Auto Screed)	-	-	-	-	

- (1) Type 3 W.C. mixture shall contain a minimum of 15 percent screening based on total aggregates.
- (2) Type 5B mixture is intended for bases under P.C.C. pavements and shoulder bases and low traffic roads only.
- (3) Substitution of AC-20 for AC-40 in Types 1, 4 and 5(A) mixtures must have approval of engineer. No substitutions permitted for Types 3, 5(B).
- (4) Type A - Crushed gravel, B - Crushed slag, C - Crushed stone approved for wearing surface, D – Crushed Stone, F - Expanded clay. Crushing not required in base mixtures.
- (5) When Type 4 mixture is used for shoulder W.C., design values shall be same as Type 4.
- (6) When W.C. mixture is substituted for binder course, the mix shall meet all physical requirements for wearing course mixtures.
- (7) When 100% of the aggregate is crushed limestone, the mineral filler may be reduced or eliminated with prior approval from the engineer. When crushed limestone is used as the coarse aggregate only, the mineral filler will be required as shown.

204.6 ASPHALTIC CONCRETE FRICTION COURSE

204.6.1 General. The friction course shall be composed of asphalt cement with anti-stripping additive and either slag, expanded clay or crushed stone at the contractor's option.

204.6.2 Materials.

204.6.2.1 Asphalt Cement. Asphalt cement shall conform to Subsection 204.1. The type material used shall be asphalt cement Grade AC-40 containing an anti-stripping additive, added at the approximate rate of 0.5 percent by weight of asphalt cement and thoroughly mixed as described in Subsection 204.5. The anti-stripping additive shall be approved by the Engineer prior to use.

204.6.2.2 Aggregates. Slag, expanded clay and crushed stone aggregates shall conform to Subsection 200.6.

All aggregates will be sampled at the plant site prior to incorporation in the mixture.

Gradation of the finished mixture as obtained from extracted samples shall be as follows:

<u>U.S. Sieve</u>	<u>Percent Passing (By Dry Weight)</u>
$\frac{1}{2}$ " (12.7mm)	100
$\frac{3}{8}$ " (9.5 mm)	90 to 100
No. 4	20 to 50
No. 10	0 to 15
No. 200	0 to 6

204.6.3 Proportioning. Mixture of materials shall be proportioned as follows:

	Percent Asphalt	Percent Aggregate	Percent Crushed Retained on No. 4 Sieve
Slag	6 - 12	88 - 94	-
Expanded Clay	13 - 17	83 - 87	-
Crushed Stone	4 - 10	90 - 96	95 (min.)

The contractor shall submit for the engineer's approval, a job mix formula for the mixture to be supplied for the project. The job mix formula shall be within the allowable tolerances of these specifications. This formula shall consist of proposed gradation, asphalt content, mixing time and mixing temperature. The approved job mix formula for the mixture shall be in effect until a modification is approved by the engineer. Should a change in sources of materials be used, a new job mix formula shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, the contractor may submit a new job mix formula.

The application of job mix formula and allowable tolerances for control of mix shall be in accordance with Subsections 204.5.3.1 and 204.5.3.2 with the following amendments. Table I of Subsection 204.5 deleted and the following substituted therefore.

TABLE I
JOB MIX FORMULA CONTROL LIMITS

U.S. Sieve	Individual	Average of 2 Tests
$\frac{3}{8}$ (9.5 mm)	± 10	± 7
No. 4	± 10	± 7
No. 10	± 9	± 6
No. 200	± 3	± 2
Percent Asphalt	± 6	± 4
Temperature of Mix °F (°C)	± 25 (± 14)	± 25 (± 14)

Based on the approved mixing temperature measured after discharge. Mixing shall be accomplished to give a minimum coating of 95 percent of coarse aggregate particles when tested by AASHTO Designation: T 195.

204.7 BITUMINOUS SLURRY SEAL

204.7.9 Description. This item shall consist of a mixture of mineral aggregates portland cement or hydrated lime, emulsified asphalt and water properly proportioned, mixed for the purpose of spreading on either existing pavement or shoulders.

204.7.2 Materials

204.7.2.1 Mineral Aggregate. Mineral aggregate shall consist of sound and durable clay aggregate, slag, granite or asphaltic limestone screening. The material shall be free from dirt, organic matter, clay balls, clay films, dust or other objectionable matter. Aggregate shall be non-plastic and meet the following gradation requirements:

U.S. Sieve	Percent Passing
3/8" (9.5 mm)	100
No. 4	85-100
No. 16	40-80
No. 50	10-35
No. 100	10-25
No. 200	5-20

Expanded clay aggregate shall be manufactured by the rotary kiln process and consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated pieces, or other deleterious substances. Expanded clay aggregate shall not show an abrasion loss of more than 40% by the Los Angeles abrasion test. The loss on soundness shall not exceed 10% after 5 cycles by the magnesium sulphate method.

Crushed slag shall be air-cooled, blast furnace slag, and shall consist of angular fragments reasonably free from flat or elongated pieces, dirt or other objectionable matter. Crushed slag shall not show an abrasion loss of more than 40% by the Los Angeles abrasion test. The slag shall not contain more than 10% by weight of glassy particles and the crushed slag shall have a minimum dry weight of 70 pounds per cubic foot.

Granite shall consist of clean, tough durable stone and shall not show an abrasion loss of more than 40% by the Los Angeles abrasion test. The loss on soundness shall not exceed 15% by weight when subjected to 5 cycles of the magnesium sulfate soundness test.

Asphaltic limestone shall be crushed natural asphaltic limestone and shall consist of limestone rock which has been impregnated by the forces of nature with not less than two per cent bitumen, practically free from dirt, decomposed rock and other foreign matter. Limestone shall show a percent wear of not more than 40 by the Los Angeles Abrasion Test.

204.7.2.2 Bituminous Material. The binder used shall be a SS-1h grade anionic emulsified asphalt or a CSS-1h grade quick setting cationic emulsion as specified in Subsection 204.3. The binder and the aggregate shall be compatible, to obtain a homogeneous slurry mix.

204.7.2.3 Water. Water used in the mix shall be potable and free from an appreciable amount of soluble salts.

204.7.2.4 Portland Cement or Hydrated Lime. Portland cement shall conform to the requirements given

in AASHTO Designation: M85. Hydrated lime shall conform to the requirements given in ASTM Designation: C207.

204.7.2.5 Additives. The contractor is advised that certain quickset emulsions require additives to regulate the breaking time of the emulsion. If an additive is recommended by the emulsion producer, the contractor shall have a sufficient quantity of this additive on the job to use as deemed necessary.

204.7.3 Slurry Mixing Test. The aggregate and quickset bituminous material shall form a free flowing, smooth, creamy, homogeneous slurry with no segregation and be capable of being stirred with no evidence of balling or stiffening for a minimum period of 2 minutes when tested in accordance with Louisiana DOTD Designation: TR 315.

204.7.4 Slurry Setting Test. When pressed lightly with a piece of white paper towel, the slurry mix shall show No Brown Stain when tested in accordance with Louisiana DOTD Designation: TR315.

204.7.5 Proportioning. The mixture shall be composed of mineral aggregate, Portland cement or hydrated lime used in the mixture shall be from 1 1/2% to 4% of the mineral aggregate by volume. The amount of emulsified asphalt used in the mixture shall be approximately 15% to 30% by volume of the mineral aggregate. The minimum amount of water necessary to obtain a fluid and homogeneous mixture shall be added. The amount of water in the mixture may be varied slightly for various surface condition. The contractor shall make trial batches, at his expense, to determine the final blend of materials to be used, within the limits set forth herein.

204.8 SOIL ASPHALT ROAD MIX

204.8.1 Description. Soil asphalt road mix shall be composed of a compacted mixture of soil and asphaltic material. The soil and asphaltic material shall not be mixed when the ambient temperature is below 60° F (15°C) and is falling. The asphaltic mixture shall be mixed or placed only when weather conditions, in the opinion of the Engineer, are favorable.

204.8.2 Materials.

204.8.2.1 Soil. Soil shall consist of approved soil, free from vegetation or other objectionable matter and may be either the material encountered in the existing roadbed; the material secured from sources shown on the plans or approved by the Engineer; or of a combination of existing material and additional soil from approved sources, all as shown on plans.

Where plans provide for the use of additional soil from approved sources, the pits utilized shall be cleaned of all grass, roots, vegetation or other objectionable matter; and overburden and any other material considered unacceptable by the Engineer shall be removed from the pits. The pits shall be opened in such manner as to expose all the various strata of acceptable material, and unless otherwise directed, the material shall be secured in successive vertical cuts extending through all of the exposed strata, in order that a uniformly mixed material will be secured.

It is the intention of this specification to utilize materials existing on the road-bed where they are of such quality as to produce the results desired. Where satisfactory materials do not exist, material secured from approved sources shall be mixed with the existing soil or shall be furnished in sufficient quantity to construct the entire base course, all as shown on plans.

The Engineer may vary the proportions of the different types of soil to produce the most satisfactory material within the soil constant limits specified.

When the processed soil is properly tested by standard laboratory methods, the material shall meet the requirements indicated on plans.

204.8.2.2 Asphaltic Material (Road Oil). The asphaltic material shall be of the type and grade shown on

plans, and shall conform to requirements for the grade specified, as described in the following table.

ROAD OILS

TYPE-GRADE	RO-3		RO-4		RO-95	
	Min.	Max.	Min.	Max.	Min.	Max.
Water, %	-	0.2	-	0.2	-	0.2
Asphalt content of 85 to 115 penetration by vacuum distillation	60	-	55	-	80	-
Flash Point, C.O.C., F (C)	225 (107)	-	175 (69)	-	250 (121)	-
Furol Viscosity: At 122F (49C), sec at 140F (60C), sec.	- 200	- 320	100 -	160 -	- -	- -
Loss at 212F (100C), 20g., 5 hrs., %	-	6.0	-	6.0	-	-
Loss at 325F (164C), 50g., 7 hrs., %	-	-	-	-	2.0	6.0
Penetration of residue after evaporation loss, 100g., 5 sec.	-	-	-	-	175	250
Ductility of residue at 77F (25C) 5 cm/min., of cms	100	-	100	-	-	-
Solubility in Trichloroethylene, %	99.0	-	99.0	-	99.0	-
Ficat Test at 122F (49C), sec.	-	-	-	-	140	175
Spot Test	Neg.		Neg.		Neg.	
Test on 85 to 155 penetration residue by vacuum distillation residue by weight, %	-	-	-	-	80	-
Ductility, 77F (25C), 5 cms/min., original residue, cms	-	-	-	-	100	-
Subjected to Thin Film Test, cms	-	-	-	-	100	-

204.9.1 Asphalt Material Additives.

- (a) Anti-Strip: Anti-strip additives for asphalt materials shall be approved products listed in QPL 57 and will be tested in accordance with DOTD TR 317.
- (b) Silicone: Silicone additives for asphalt materials shall be approved products listed in QPL 22.
- (c) Polymers: Polymer modified asphalt materials shall be approved products listed in QPL 41. Polymer additives shall be preblended with the asphalt material. In-line blending will not be allowed.

Table 204.9-I
Performance Graded Asphalt Cements

Property	AASHTO Test Method	PG76-22m ¹		PG70-22m ¹		PG64-22 ¹		PG58-28 ¹	
		Spec.	Deviation	Spec.	Deviation	Spec.	Deviation	Spec.	Deviation
Test on Original Binder		100	90 or Remove	100	90 or Remove	100	90 or Remove	100	90 or Remove
Rotational Viscosity @ 135°C, Pa-s ²	TP 48	3.0	---	3.0	---	3.0	---	3.0	---
Dynamic Shear, 10 rad/s, G*/Sin Delta, kPa	TP 5	1.00+ @ 76°C	0.99-	1.00+ @ 70°C	0.99-	1.30+ @ 64°C	1.29-	1.00+ @ 58°C	0.99-
Flash Point, °C	T 48	232+		232+		232+		232+	---
Solubility, % ³	T 44	99+	---	99+	---	99+	---	99+	---
Separation of Polymer, 163 °C, 48 hours, °C difference in R & B from top to bottom ⁴	DOTD TR 326	2-	---	2-	---	---	---	---	---
Force Ductility Ratio (f2/f1, 4°C, 5 cm/min., f2 @ 30 cm elongation)	T 300	0.30+	0.29-	---	---	---	---	---	---
Force Ductility, 4°C, 5 cm/min, 30 cm elongation, kg	T 300	---	---	0.23+	0.22-	---	---	---	---
Tests on Rolling Thin Film Oven Residue	T 240	---	---	---	---	---	---	---	---
Dynamic Shear, 10 rad/s, G*/Sin Delta, kPa	TP 5	2.20+ @76°C	2.19-	2.20+ @70°C	2.19-	2.20+ @64°C	2.19-	2.20+ @58°C	2.19-
Elastic Recovery, 25° C, 10 cm elongation, % ⁵	T 301	60+	59-	40+	39-	---	---	---	---
Ductility, 25° C, 5 cm/min, cm	T 51	---	---	---	---	100+	99-	---	---
Test on Pressure Aging Vessel Residue	PP I								
Dynamic Shear, @ 25 °C, 10 rad/s, G* Sin Delta, kPa	TP 5	5000-	---	5000-	---	5000-	---	5000-@ 19°C	---
Bending Beam Creep Stiffness, S, MPa @ -12°C.	TP I	300-	---	300-	---	300-	---	300- @ 18°C	---

¹ PG76-22m or PG70-22m shall be required in the top two lifts of all hot mix asphalt construction for roadways; PG64-22 may be used in base course and incidentals; when 20-30% RAP is used in the base course PG 58-28 is required.

² The rotational viscosity will be measured to determine product uniformity. The rotational viscosity measured by the supplier shall be noted on the Certificate of Delivery. A binder having a rotational viscosity of 3.0 Pa-s or less will typically have adequate mixing and pumping capabilities. Binders with rotational viscosity values higher than 3.0 Pa-s should be used with caution and only after consulting with the supplier as to any special handling procedures and guarantees of mixing and pumping capabilities.

³ Not all polymers are soluble in the specified solvents. If the polymer modified asphalt digested in the solvent will not pass the filter media, a sample of the base asphalt used in making the polymer modified asphalt should be tested for solubility. If the solubility of the base asphalt is at least 99.0%, the material will be considered as passing.

⁴ Separation of Polymer Test - to be used for preblended modified asphalt cement materials.

⁵ AASHTO T 301 except the standard v-shaped sides for the specimen mold shall be replaced by straight-sided inserts of the same length, so that the specimen will contain a section 1 cm x 1 cm x 3 cm.

Table 204.9-2

PG 70-22m Alternate ¹

Property	AASHTO Test Method	PG 70-22m Alternate ²	
		Specification	Deviation
		100	90 or Remove
Test on Original Binder:			
Rotational Viscosity @ 135°C, Pa-s ³	TP 48	3.0-	---
Dynamic Shear, @ 70°C and 10 rad/s, G*/Sin Delta, kPa	TP 5	1.50+	1.49-
Flash Point °C	TP 48	232+	---
Solubility % ⁴	T 44	99+	---
Softening Point, Ring & Ball °C	T 53	70.0+	69.9-
Test on Rolling Thin Film Oven Residue:	T 240		
Mass Loss %	T 240	1.00-	1.01+
Dynamic Shear, @ 70°C and 10 rad/s, G*/Sin Delta, kPa	TP 5	2.20+	2.19-
Test on Pressure Vessel Aging Residue	PP I		
Dynamic Shear, @ 25°C and 10 rad/s, G*/Sin Delta, kPa	TP 5	5000-	---
Bending Beam Creep Stiffness, S @ -12°C, MPa	TP I	300-	---
Bending Beam Creep Slope, @ -12°C, m value	TP I	0.003+	---

¹ Use only with Superpave asphaltic concrete Level I and Level A mixes with less than 2500 ADT.

² Handling of all samples for testing shall be in accordance with ASTM D 4957, Section 7.2, which requires heating the sample in an oven maintained at 190° ± 2°C. Stir the sample occasionally until homogenous and pour in suitable container for testing. Pouring temperatures shall be 180° ± 2°C for all tests.

³ The rotational viscosity will be measured to determine product uniformity. The rotational viscosity measured by the supplier shall be noted on the Certificate of Delivery. A binder having a rotational viscosity of 3.0 Pa-s or less will typically have adequate mixing and pumping capabilities. Binders with rotational viscosity values higher than 3.0 Pa-s should be used with caution and only after consulting with the supplier as to any special handling procedures and guarantees of mixing and pumping capabilities.

⁴ Not all polymers are soluble in the specified solvents. If the polymer modified asphalt digested in the solvent will not pass the filter media, a sample of the base asphalt used in making the polymer modified asphalt should be tested for solubility. If the solubility of the base asphalt is at least 99.0%, the material shall be considered as passing.

Table 204.9-3

Anionic Emulsified Asphalt

Test Method		Percent of Contract Unit Price/Liter or Shipment ¹					
		SS-I			SS-Ih		
		Specifications		Deviations	Specifications		Deviations
		100	80	50 or Remove ²	100	80	50 or Remove ²
Viscosity, Saybolt Furol @ 25°C, s	AASHTO T 59	20 - 100	10 - 19	9-	20-100	10-19	9-
Residue by Distillation, % by wt.	AASHTO T 59	---	101- 150	151+	---	101-150	151+
Sieve Test (Retained on 850 µm)	AASHTO T 59	57+	52 - 56	51-	57+	52-56	51-
Cement Mixing	AASHTO T 59	0.1-	---	---	0.1-	---	---
Settlement, 5-day, %	AASHTO T 59	2-	---	---	2-	---	---
Tests on Residue by Distillation:		5.0-	---	---	5.0-	---	---
Penetration, 25°C,	AASHTO T49	---			---		
100 g, 5 s, dmm		100 - 200	88 - 99	87-	40 - 90	30 - 39	29-
Solubility, %	AASHTO T 44	---	201- 212	213+	---	91 - 101	101+
Ductility, 25°C,		97.5+	---	---	97.5+	---	---
50 mm/min, cm	AASHTO T 51	40+	26 - 39	25-	40+	26 - 39	25-

¹ When material is incidental to pay item, use invoice price per liter.

² At the option of the engineer.

Table 204.9-4

Cationic Emulsified Asphalt (CRS-2, CMS-2, CSS-I and CSS-Ih)

Test Method		Percent of Contract Unit Price/Liter or Shipment ¹											
		CRS-2			CMS-2			CSS-I			CSS-Ih		
		Specifications	Deviations		Specifications	Deviations		Specifications	Deviations		Specifications	Deviations	
		100	80	50 or Remove ²	100	80	50 or Remove ²	100	80	50 or Remove ²	100	80	50 or Remove ²
Viscosity, Saybolt Furol @ 50°C, s	AASHTO T 59	100-400	56-99 401-444	55- 445+	50-450	26-49 451-499	25- 500+	---	---	---	---	---	---
Saybolt Furol @ 25°C, s	AASHTO T 59	---	---	---	---	---	---	20-100	10-19 101-150	9- 151+	20-100	10-19 101-150	9- 151+
Residue by Distillation % by wt.	AASHTO T 59	65+	61-64	60-	65+	61-64	60-	57+	52-56	51+	57+	52-56	51+
Oil Distillate by Volume, %	AASHTO T 59	30-	---	---	12.0-	---	---	---	---	---	---	---	---
Particle Charge Sieve Test	AASHTO T 59	Pos.	---	Neg.	Pos.	---	Neg.	Pos.	---	Neg.	Pos.	---	Neg.
(Retained on 850 µm), %	AASHTO T 59	0.1-	---	---	0.1-	---	---	0.1-	---	---	0.1-	---	---
Settlement, 5-days, %	AASHTO T 59	5.0-	---	---	5.0-	---	---	5.0-	---	---	5.0-	---	---
Tests on Residue by Distillation:													
Penetration, 25°C,	AASHTO T 49	100-250	84-99	83-	100- 250	84-99	83-	100- 200	89-99	87-	40-90	30-39	29-
100 g 5 s, dmm			251-266	267+		251-266	267+		201-212	213+		91-100	101+
Solubility, %	AASHTO T 44	97.5+	---	---	97.5+	---	---	97.5+	---	---	97.5+	---	---
Ductility, 25°C, 5 cm/min, cm	AASHTO T 51	80+	66-79	65-	40+	26-39	25-	40+	26-39	25-	40+	26-39	25-
Viscosity, 135°C, Pa-s	AASHTO T 48	0.18+	0.13-0.17	0.12-	---	---	---	---	---	---	---	---	---

¹ When the unit of pay is not based on the liter, the deduction will be applied to the contract unit price.

² At the option of the engineer.

Table 204.9-5

Emulsified Polymerized Asphalt (CRS-2P)¹

Test Method		Percent of Contract Unit Price/Liter or Shipment ²		
		Specifications		Deviations
		100	80	50 or Remove ³
Viscosity, Saybolt Furol @ 50°C	AASHTO T 59	100 - 400	56 - 99	55-
Storage Stability Test, 24 h, %	AASHTO T 59	1.0-	---	---
Settlement, 5 Day, %	AASHTO T 59	5.0-	---	---
Classification Test	AASHTO T 59	Pass	---	Fail
Particle Charge Test	AASHTO T 59	Pos.	---	Neg.
Sieve Test (Retained on 850 µm), %	AASHTO T 59	0.1-	---	---
Distillation:	AASHTO T 59	3.0-	---	---
Oil Distillate by Vol. of Emulsion, %		65+	---	---
Residue from Distillation, %			61-64	60-
Tests on Residue by Distillation:				
Penetration, 25°C, 100 g, 5 s, dmm	AASHTO T 49	10 - 20	8 - 10 20 – 22.5	8- 23+
Softening Point (Ring & Ball), °C	AASHTO T 53	38.0+	32.1 – 37.9 52.1 – 58.9	32.0- 59.0+
Solubility, %	AASHTO T 44	97.5+	---	---
Tests on Residue by Evaporation ⁴ :				
Force Ductility Ratio (f2/f1, 4°C, 5 cm/min, f2 at second peak)	AASHTO T 300	0.30+	0.21 – 0.29	0.20-
Elastic Recovery, 10°C 20 cm elongation, %	AASHTO T 301 ⁵	58+	51 – 57	50-

¹ The addition of latex, rubber or other additives to emulsified polymerized asphalt will not be allowed.

² When the unit of pay is not based on the liter, the deduction will be applied to the contract unit price.

³ At the Department's option.

⁴ The residue asphalt for running ductility tests, tensile stress test and elastic recovery test shall be obtained by means of residue by evaporation (Oven) rather than residue by distillation (Aluminum -alloy Still). The material supplier shall certify by independent testing that the Tensile Stress requirements have been attained.

⁵ AASHTO T 301 except the standard v-shaped sides for the specimen mold shall be replaced by straight-sided inserts of the same length, so that the specimen will contain a section 1 cm x 1 cm x 3 cm.

Table 204.9-6

MC Cutback Asphalt

Test Method		Percent of Contract Unit Price/Liter or Shipment ¹								
		MC-30			MC-70			MC-250		
		Specifications	Deviations		Specifications	Deviations		Specifications	Deviations	
		100	80	50 or Remove ²	100	80	50 or Remove ²	100	80	50 or Remove ²
Flash Point, Open Tag, 0C	AASHTO T 79	38+	---	---	38+	---	---	66+	---	---
Viscosity, Saybolt Furol @ 25 °C, s	AASHTO T 72	75 - 150	58	57-168+	---	---	---	---	---	---
60 °C, s		---	---	---	35 - 70	24 - 34 71 - 81	23-82+	125 - 250	100 - 124 251 - 275	99-276+
Distillation Test, Distillate Percentage by Volume of Total Distillate to 360° C	AASHTO T 78	0.0 – 25.0	---	---	0.0 – 20.0	---	---	0.0 – 10.0	---	---
to 225 °C		40.0-	---	---	20.0 - 60.0	---	---	15.0 - 55.0	---	---
to 260 °C		70.0-	---	---	65.0 - 90.0	---	---	60.0 - 87.0	---	---
to 316 °C		75.0								
Residue from Distillation to 360 °C, Volume Percentage of Sample by Difference		93.0-	45.1 - 49.9	45.0-	55.0+	50.1 - 54.9	50.0-	67.0+	62.1 - 66.9	62.0-
Tests on Residue by Distillation:										
Penetration, 25 °C, 100 g, 5 s, dmm	AASHTO T 49	50.0+	102 - 119 251 - 268	101-269+	120 - 250	102 - 119 251 - 268	101-269+	120 - 250	102 - 119 251 - 268	101-269+
Solubility, %	AASHTO T 44	120 - 250	98.6 - 98.9	98.5-	99.0+	98.6 - 98.9	98.5-	99.0+	98.6 - 98.9	98.5-
Ductility, 25 °C, for Residues to 200 Penetration, 5 cm/min, cm	AASHTO T 51	99.0+	76 - 99	75-	100+	76 - 99	75-	100+	76 - 99	75-
Ductility, 15.5°C, for Residues of 200-300 Penetration, 5 cm/min, cm	AASHTO T 51	100+	76 - 99	75-	100+	76 - 99	75-	100+	76 - 99	75-

¹ When material is incidental to the pay item, use invoice price per liter.

² At the option of the engineer.

Table 204.9-7**Cationic Emulsified Petroleum Resin (EPR-I)**

Test Method		Percent of Contract Unit Price/Liter or Shipment ¹		
		Specifications	Deviations	
		100	80	50 or Remove ²
Viscosity, Saybolt Furol @ 250C, s	AASHTO T 59	15 - 100	10 -15	9-
Residue by Evaporation, % by wt.	AASHTO T 59	57+	101 - 150	151+
Particle Charge	AASHTO T 59	Pos.	52 - 56	51-
Sieve Test (Retained on 850 µm), %	AASHTO T 59	0.1-	---	Neg.
Settlement, 5 Days, %	AASHTO T 59	5.0-	---	---

¹ When the unit of pay is not based on the liter, the deduction will be converted to an equivalent deduction in terms of unit of pay.

² At the option of the engineer.

Table 204.9-8**AEP Emulsified Asphalt**

Test Method		Percent of Contract Unit Price/Liter or Shipment ¹		
		Specifications	Deviations	
		100	80	50 or Remove ²
Viscosity, Saybolt Furol @ 500C, s	AASHTO T 59	15 - 150	10 -15 151 - 200	9- 201+
Residue by Evaporation, % by wt.	AASHTO T 59	50+	46 - 49	45-
Oil Distillate by Volume, %	AASHTO T 59	25.0-	---	---
Sieve Test (Retained on 850 µm), %	AASHTO T 59	0.1-	---	---
Storage Stability, 24 h, %	AASHTO T 59	1.0-	---	---
Settlement, 5 Days, %	AASHTO T 59	5.0-	---	---
Test on Residue by Evaporation:				
Penetration, 250C, 100 g, 5 s, dmm	AASHTO T 49	250+	---	---
Solubility, %	AASHTO T 44	97.5+	---	---

¹ If material is incidental to the pay item, use invoice price per liter.

² At the option of the engineer.

Table 204.9-9

Anionic Emulsified Polymer Modified Asphalt

Property	Test Method	SS-IP		
		Specification	Deviation	
		100	80	50 or Remove
Viscosity, Saybolt Furol @ 25°C, s	AASHTO T 59	20-100	10-19 101-150	9- 151+
Storage Stability, 24 Hour, %	AASHTO T 59	1.0-	---	---
Sieve Test, retained on the No. 20, %	AASHTO T 59	0.1-	---	---
Residue by Evaporation,% Tests On Residue From Evaporation Test:	AASHTO T59	57+	---	56-
Penetration, 25°C, 100g, 5s, dmm	AASHTO T 49	100-200	88-99 201-212	87- 213+
Solubility, %	AASHTO T 44	97.5+	---	---
Force Ductility Ratio f2/f1, 4°C, 5 cm/min, f2 @ 30 cm elongation	AASHTO T 300	0.15+	---	0.14-
Elastic Recovery ¹ , 10°C, 20 cm elongation, %	AASHTO T 301	30+	---	29-

¹ AASHTO T 301 except the standard v-shaped sides for the specimen mold shall be replaced by straight-sided inserts of the same length, so that the specimen will contain a section 1 cm x 1 cm x 3 cm.

Table 204.9-11

Hot Applied Modified Asphalt Cements for Asphalt Surface Treatment ¹

Property	AASHTO Test Method	Gelled Asphalt		PAC 15	
		Spec.	Deviation	Spec.	Deviation
		100	90 or Remove	100	90 or Remove
Tire Rubber Content, %	---	---	---	5+	---
Penetration @ 250C, 100 g., 5 s, dmm	T 49	55 - 100	54-100+	75-125	74 126+
Viscosity, @ 600C, Pa-s	T 202	100+	99-	150+	149-
Rotational Viscosity @ 1350C, Pa-s ²	TP 48	0.7-3.0	0.6-3.1+	3.0-	3.1+
Force Ductility Ratio, f2/f1, 40C, 5cm/min, f2 @ 30 cm elongation	T 300	---	---	0.30+	0.29-
Softening Point, 0C	T 53	53+	52-	45+	44-
Flash Point, 0C	T 48	230+	228-	230+	228-
Solubility, %	T 44	99.0+	---	---	---
Separation of Rubber, 163 °C, 48 hours difference in R & B from top to bottom sample, 0C	DOTD TR 326	---	---	2-	---
Tests on Residue from Rolling Thin Film Oven Test:	T 240				
Elastic Recovery, 25 0C, 10 cm elongation, %	T 301 ³	---	---	55+	54-
Penetration Retention 25 0C, RTFO/Original	T 49	---	---	0.60+ 1.00-	0.59- 1.01+
Viscosity Ratio, 60 0C, RTFO/ Original	T 202	2.5-	2.6+	---	---

¹ Handling of all samples for testing shall be in accordance with ASTM D 4957, Section 7.2, which requires heating the sample in an oven maintained at 195° ± 2°C. Stir the sample occasionally until homogenous and pour in suitable container for testing. Pouring temperatures shall be 180° ± 2°C for all tests.

² The rotational viscosity will be measured to determine product uniformity. The rotational viscosity measured by the supplier shall be noted on the Certificate of Delivery. A binder having a rotational viscosity of 3.0 Pascal or less will typically have adequate mixing and pumping capabilities. Binders with rotational viscosity values higher than 3.0 Pascal should be used with caution and only after consulting with the supplier as to any special handling procedures and guarantees of mixing and pumping capabilities.

³ AASHTO T 301 except the standard v-shaped sides for the specimen mold shall be replaced by straight-sided inserts of the same length, so that the specimen will contain a section 1 cm x 1 cm x 3 cm.

SECTION 205

TIMBER AND PRESERVATIVE TREATMENT

205.1 LUMBER AND PLYWOOD

205.1.1 General. Unless otherwise specified or shown on the drawings, all lumber shall be one of the following species at the Contractor's option: Southern Yellow Pine or Douglas Fir. Lumber shall conform to the applicable requirements of AASHTO M-168 and the following requirements.

205.1.2 Southern Pine Lumber. Southern Pine lumber shall be furnished in grades as published by the Southern Pine Inspection Bureau at the Southern Pine Association in the latest edition of the "Standard Grading Rules for Southern Pine Lumber". Lumber shall be furnished in grades with definite working stresses assigned as indicated for grade of lumber required.

- (a) Grade No. 1 Dense SR Timbers shall be furnished for caps, stringers, decking and bridge rails.
- (b) Grade No. 1 SR Timbers for items other than caps, stringers, decking and bridge rail.

205.1.3 Douglas Fir. Unless otherwise specified, Douglas Fir shall be selected as to grade and shall conform in all particulars to the Standard Grading Rules for Western Lumber, published by the Western Wood Products Association and approved by the American Lumber Standards Committee.

- (a) Select structural shall be furnished for caps, stringers, decking and bridge rails.
- (b) Grade No. 1 shall be furnished for items other than caps, stringers, decking and bridge rails.

205.1.4 Plywood. Plywood shall be manufactured and graded in accordance with the rules of the American Plywood Association and the latest Product Standard for Softwood Plywood, Construction and Industrial, of the National Bureau of Standards. Plywood used for concrete form work shall be B-B grade, exterior glue, Plyform class V edge sealed.

205.1.5 Grade Marking.

205.1.5.2 Plywood. Each sheet of plywood shall bear the official stamp of a quality control agency stating the grade of the sheet.

205.2 PRESERVATIVE TREATMENT.

205.2.1 General. Lumber and timber or piling to be treated shall conform to the requirements of the various sections of these specifications.

All preservatives used shall comply with the applicable standards contained in the Manual of Recommended Practice of the American Wood Preservers' Association (AWPA).

Where practical, wood to be treated shall be cut to final size, trimmed, and have all holes drilled prior to treatment. All piling shall be machine peeled prior to treatment and shall have a minimum of 1 inch of sapwood.

Wood shall be conditioned, seasoned, prepared and treated by pressure process in accordance with the applicable standards contained in the AWPA Manual.

Wood measuring 3 inches (76 mm) or more in thickness shall be incised on all four sides by a machine having power driven rolls designed to incise to a uniform depth. The incisor teeth shall be either wedge-shaped or chisel-shaped with sharp points and edges so designed that upon entering and leaving the wood, a separation and spreading of the fibers is accomplished.

205.2.2 Timber Preservatives. The preservative used shall be creosote except when one of the following water-borne salt preservatives is specified:

Creosote Coal - AWWA P1/P13
 Tanalith (Wolman Salts)
 Pentachlorophenol - Petroleum - AWWA P8 and P9
 Chromated Copper Arsenate - AWWA P5, Type B or C
 Creosote for Repairs - AWWA M4

205.2.3 Retention and Penetration for Treated Wood. The minimum amount of preservative to be retained in the wood and the depth of penetration shall be as shown in the following table:

	Land Use		Marine Use	
	lbs/cf (kg/m ³)	Depth (mm)	lbs/cf (kg/m ³)	Depth (mm)
Lumber and Timber	*12 (192)	$\frac{5}{8}$ " (15.9)	20 (320)	$\frac{3}{4}$ " (19.1)
Piles	16 (256)	$\frac{3}{4}$ " (19.1)	20 (320)	1" (25.4)

*Empty Cell Process

205.2.4 Field Treatment of Cut Surfaces. When sawing or drilling is necessary after plant treatment, the cut surfaces shall be thoroughly brushed with two coats of the same kind of preservative in conformance with AWWA Specification M-4. The maximum protection requirement specified therein shall be met in all instances.

205.2.5 Inspection. All materials treated shall be subject to inspection. Defects that develop as a result of the treating operation may be cause for rejection. Inspection shall be in accordance with AWWA Standard M-2 and quality control shall be in accordance with AWWA Standard M-3.

205.2.6 Marking. Each accepted pile and piece of lumber or timber shall be stamped with a readily legible stamp which will make an impression in the wood indicating acceptance by the Agency. This shall be done after treatment but before shipment. Piles shall be stamped on the butt end; lumber and timber shall be stamped on one end.

Upon request of the Engineer, a true impression of the stamp shall be delivered to the Engineer before delivery of the treated material, together with an itemized report of all lumber and piles inspected, giving temperatures, amount and grade of preservatives, time of treatment, lengths and sizes of material, total footage, and other pertinent data. Treated material which does not bear the stamp of the inspection in legible form will be rejected.

205.2.7 Handling and Protection of Treated Materials. In handling treated material, care shall be exercised so as not to damage the edge of abrade the surfaces to the extent of reducing the depth of treated wood or exposing any wood not penetrated by the preservative. The use of cant hooks, peavies, or sharp pointed tools, etc., for the handling of treated lumber and the use of metal slings without protective guards will not be permitted.

Material that is stored on the site of work prior to its use shall be piled neatly on skids to raise it from the ground, and shall be protected from the sun and weather when required by the Engineer.

SECTION 206

PILES

206.1 TIMBER PILES

206.1.1 General. Timber piles shall be Southern Yellow Pine or Douglas Fir, unless otherwise indicated by the plans.

206.1.2 Quality. Piles shall conform to ASTM D 25 for Class A, B and C Piles and the requirements contained herein. Piles shall be cut from sound, live, close-grained trees, and shall be free from large, loose or unsound knots, scars, decay, holes, insect damage, barnacles, limnoria or other forms of sea life, and other defects or imperfections that would materially impair their strength or durability.

All piles shall be machine peeled and all inner skin shall be removed. All branch stubs and partially overgrown knots shall be neatly trimmed with the surface, and the butts and tips shall be sawed square with the longitudinal axis of the pile.

206.1.3 Dimensional Requirements. The diameter of a pile at any section shall be considered as the average diameter at such section measured at right angles to the longitudinal axis of the pile; but in determining an average diameter, no single diameter that is more than 10 percent greater than the least diameter at the same section shall be used. The butt and tip diameters of timber piles shall be such as to conform with the requirements indicated therefore in the following tabulation and the diameter 3 feet (.91 m) from the butt shall not be smaller than 1 inch (25.4 mm) less than that at the butt.

Length Feet (m)		<u>3 Feet From Butt</u>				<u>At Tip Minimum</u>	
		<u>Minimum</u>		<u>Maximum</u>			
		Circum- ference Inches (mm)	Dia. (Approx.) Inches (mm)	Circum- ference Inches (mm)	Dia. (Approx.) Inches (mm)	Circum- ference Inches (mm)	Dia. (Approx.) Inches (mm)
Under 40	(12.2)	38 (965)	12 (305)	63 (1800)	20 (508)	25 (635)	8 (203)
40 to 54	(12.2) (16.6)	38 (965)	12 (305)	63 (1800)	20 (508)	22 (559)	7 (178)
55 to 74	(16.7) (22.7)	41 (1041)	13 (320)	63 (1800)	20 (508)	22 (559)	7 (178)
75 to 90	(22.8) (27.4)	41 (1041)	13 (320)	63 (1800)	20 (508)	19 (483)	6 (152)
Over 90	(27.5)	41 (1041)	13 (320)	63 (1800)	20 (508)	16 (406)	5 (127)

The average diameter of the heartwood at the butt of Southern Yellow Pine or Douglas fir piles that are to be treated shall be not less than 70 percent, and of those that are to be used untreated not less than 75 percent, of the average outside butt diameter of the pile.

A straight line from the center of the butt to the center of the tip of pile shall lie entirely within the body of the

pile.

206.2 STEEL PILES

206.2.1 General. Steel bearing piles furnished under this specification shall consist of structural steel shapes that fulfill the requirements prescribed for such material in ASTM A 36 and shall conform to the details and dimensions indicated by the drawings and specifications relating directly thereto.

Splices in steel piles shall be made by a full penetration butt weld of the entire cross section. Care shall be taken to properly align adjacent sections so that the axis of the pile will be straight. The number of splices in the length of the pile shall be limited to two. Splices in the top 10 feet (3 m) of the piles will not be permitted. The locations of pile lugs, when used, shall be subject to the approval of the Engineer. All welding shall be performed by qualified welding operators in accordance with Subsection Material for steel piles shall not be made by the acid Bessemer process.

206.3 CONCRETE PILES

206.3.1 General. The types of concrete piles covered by these specifications are precast, cast-in-place, and prestressed piles. The type to be used or furnished shall be as indicated on the drawings. Steel and concrete shall be placed in accordance with the provisions of Section 601. Portland cement concrete and reinforcing steel shall conform to the provisions of Subsections 201.1 and 201.2 respectively. Compressive strength tests for precast and prestressed piles shall be performed in accordance with ASTM C 31.

206.3.2 Precast Piles. Precast concrete piles shall be of such quality that the finished piles can be handled and driven to required bearing without cracking or other damage which would impair their strength or durability. Concrete shall have a minimum strength of 4,000 psi (27.6 MPa) at 28 days.

Concrete for precast concrete piles shall be cast in smooth, mortar tight forms so supported as to prevent appreciable deformation or settlement during concrete placement or curing. The piles after being cast shall be cured by water, steam, curing compound, or such other method of curing as may be approved by the Engineer. Curing shall be continued until specimens of the concrete from which the piles were cast attain a compressive strength of at least 4,000 psi (27.6 MPa). Piles shall not be driven until completion of the specified curing.

The piles shall present true, smooth, even surface, free from honeycombs or voids and shall be sufficiently straight that a line stretched from butt to tip along any face will not deviate nor be deflected therefrom more than one inch (25.4 mm) in 50 feet (15.2 m) at any point. Defects in any pile may be accepted if repaired to the satisfaction of the Engineer.

Concrete piles may be cast the full length of the reinforcing bars provided that, after the piles have been driven, the concrete is removed to expose the steel as shown on the plans.

206.3.3 Cast-in-Place Concrete Piles

206.3.3.1 Metal-Cased Cast-in-Place Concrete Piles. Piles shall be cast in steel casing shells that have been previously driven to the penetration or bearing value required by the Engineer. The shell shall be cylindrical and may be fluted, step-tapered, or uniformly tapered from butt to tip.

Shells that are driven without a mandrel shall be equipped with steel driving tips and shall be constructed of material conforming to the requirements prescribed in ASTM A 252, Grade 2. They shall be of sufficient thickness (9 gage minimum), strength, and rigidity to withstand distortion from driving, soil pressure, or the driving of adjacent piles. Continuous welds shall be used at all shell splices to develop the full strength of the section.

After being driven, but prior to placing of the reinforcing steel and concrete, the shells shall be examined for collapse or reduced diameter. Shells that are improperly driven, broken, or show partial collapse, shall be replaced by, and at the expense of, the contractor. The replacement of the shell shall be made by withdrawing the entire

shell and driving another in its place. Driving one shell within a shell already driven will not be permitted. If the withdrawal of the defective shell is impossible or impractical as determined by the Engineer, the contractor shall fill the defective shell with concrete and shall replace the defective pile with another pile driven alongside. Any enlargement of the footing required to accommodate such piling shall be at the expense of the contractor. Driven shells shall be clean and free of water before reinforcing steel and concrete are placed therein. Concrete shall be vibrated to within 5 feet (1.5 m) of the tip of the shell.

206.3.4 Prestressed Concrete Piles. The manufacture of prestressed piles shall be performed in accordance with Section 603. Concrete shall have a minimum strength at 28 days of 5000 psi (34.5 MPa). Piles shall be of such quality that the finished piles can be handled and driven to required bearing without cracking or other damage which would impair their strength or durability. Piles shall present true, smooth, even surfaces free from honeycombs or voids and shall be sufficiently straight that a line stretched from butt to tip along any face will not deviate nor be deflected therefrom more than one inch (25.4 mm) in 50 feet (15.2 m) at any point. Piles showing defects in the upper 10 feet (3 m), which reduce the cover over the steel to less than required, shall be rejected. Defects in the remainder of the pile may be accepted if repaired in a manner satisfactory to the Engineer.

Prestress forces shall not be transferred to the piles until the concrete has attained strength of 3,500 psi (24.1 Mpa)

206.3.5 Handling and Driving. Prestressed concrete piles shall be lifted or supported only at the points shown on the approved shop drawings. Piles shall not be driven until they have attained a minimum compressive strength of 5,000 psi (34.5 MPa) as determined by tests on concrete cylinders cast and cured under the same conditions as the piles.

206.4 SHEET PILING

206.4.1 General. The types of sheet piling covered by these specifications are timber (untreated and treated), reinforced concrete, and steel sheet. The type to be used or furnished shall be as indicated on the drawings.

206.4.2 Timber Sheet Piles.

206.4.2.1 General. Timber sheet piles shall be untreated unless the drawings or project specifications specifically provide for the use of treated timber. Piles shall be of thickness specified or directed and shall be provided with tongues and grooves of ample proportions, either out from the solid material or made by building up the piles with 3 planks securely fastened together. The pile shall be drift sharpened at their lower ends so as to wedge the adjacent piles tightly together during driving. Hardware shall be galvanized and shall be of sufficient size and strength to effectively secure members together and in place without displacement of members.

206.4.2.2 Untreated Timber Sheet Piles. Timber shall be in accordance with Subsection 205.1 unless otherwise specified or indicated on drawings. It shall be sawn or hewn with square corners and shall be free from worm holes, loose knots, shakes, decayed or unsound portions and other defects which might impair its strength or tightness.

206.4.2.3 Treated Timber Sheet Piles. Treated timber shall be either Southern Pine or Douglas Fir conforming to Subsection 205.1 treated with creosote oil in accordance with Subsection 205.2. All cuts in treated timber and all abrasions after having been carefully trimmed shall be covered with two applications of a mixture of 60% creosote oil and 40% roofing pitch or brush coated with at least two applications of hot creosote oil and covered with hot roofing pitch.

206.4.3 Concrete Sheet Piles. Where conventionally reinforced or prestressed concrete sheet piles are required, they shall be fabricated in accordance with the design indicated on drawings. The requirements governing the manufacture and installation of concrete sheet piling shall conform, in general, to those governing precast-prestressed concrete bearing piles in Subsection 206.3.

206.4.4 Steel Sheet Piles. Shall consist of standard interlocking sheet pile sections having positive interlocks in both longitudinal and transverse directions which are continuous throughout the entire length of the piece. Steel sheet shall be of the weight specified on drawings and shall conform to ASTM A-328.

SECTION 207

MISCELLANEOUS METAL ITEMS

207.1 STRUCTURAL STEEL.

207.1.1 General. All steel, the class of which is not definitely designated herein, or on the plans, shall be structural steel and shall conform to the requirements of ASTM A 36.

207.1.2 Certification. The contractor will furnish to the Engineer, before fabrication, a mill certified report (in duplicate) of the tests for each heat of steel or iron from which the material is to be fabricated. The certification shall contain the results of chemical and physical tests required by the ASTM specifications for the materials.

207.1.3 Mill Tolerance. Rolling and cutting tolerance, permissible variations in weight and dimensions, defects and imperfections will not exceed the limits contained in ASTM A 6.

207.1.4 High Strength Low-Alloy Structural Steel. The material shall conform to the requirements of ASTM A 242, A 440, A 441, A 606, A 607, or A 446 (Grades C, D, or E) as specified.

207.1.5 Copper Bearing Structural Steel. Copper bearing, structural steel shall conform to the requirements of ASTM A 36, A 245, A 440, A 446, or A 570 as specified.

207.2 STRUCTURAL STEEL CONNECTORS.

207.2.1 Rivets

207.2.1.1 Stock Material. Rivets taken from identifiable stock may be accepted by the Engineer based on certified mill test reports. Rivets from unidentifiable stock will not be used except where shown on the shop drawings.

207.2.1.2 High Strength Structural Steel Rivets. The material shall conform to the requirements of ASTM A 502.

207.2.1.3 Structural Steel Rivets. The material shall conform to the requirements of ASTM A 502, except that the test specimen will be bent upon itself when performing the bend test.

207.2.2 Bolts.

207.2.2.1 Unfinished Bolts. The bolts shall have square heads and square nuts unless otherwise specified. The bolts will be long enough to extend entirely through the nut but not more than 1/4 inch (6.4 mm) beyond. Bolts will be of steel conforming to the requirements of ASTM A 307.

207.2.2.2 High Strength Bolts. High strength bolts and washers shall conform to the provisions of ASTM A 325.

207.2.2.3 Anchor Bolts. Anchor bolts will be manufactured from steel conforming to ASTM A 36 or A 307.

207.3 MILD STEEL FORGINGS FOR STRUCTURAL PURPOSES. Steel forgings shall conform to the requirements of ASTM A 325. They will be Class C forgings with a maximum carbon content of 0.35% and will be given a thorough annealing. The metal shall have a minimum Brinell hardness of 130 and a maximum of 190, when tested in accordance with ASTM E 10.

207.4 STEEL CASTINGS.

207.4.1 General. Steel castings shall be true to pattern in form and dimension and free from defects that would affect the service value of the casting. Minor defects which do not impair the strength of a casting may be repaired with the approval of the Engineer. Castings which have been repaired without the permission of the Engineer may be rejected.

207.4.2 Steel Castings for Highway Bridges. Steel castings for use in highway bridge components shall conform to ASTM A 486 or A 27, Class 70 or Grade 70-36 respectively unless otherwise specified.

207.4.3 High Strength Steel Castings for Structural Purposes. Castings shall conform to ASTM A 148, Grade 80-50.

207.4.4 Mild-to-Medium Carbon-Steel Castings for General Application. Castings shall conform to ASTM A 27, Grade 65-35. The metal shall have a minimum Brinell hardness number of 130 when tested in accordance with ASTM E 10.

207.5 GRAY IRON CASTINGS.

207.5.1 General. All castings shall meet the requirements of *Standard Specification for Drainage, Sewer, Utility, and Related Castings, AASHTO Designation: M-306-05*.

207.5.2 Testing Requirements. When requested by the Engineer, testing shall be performed in accordance with ASTM A 48.

207.5.3 Manhole Frame and Cover Sets. Castings shall conform to ASTM A 48, Class 35. The bearing surfaces of the frames and covers will be machined, and the cover will seat firmly into the frame without rocking. The frames and covers will be coated as specified in Subsection 207.5.6.

207.5.4 Railings, Railing Posts, and Wheel Guards. Castings shall conform to ASTM A 48, Class 40.

207.5.5 Rockers, Rocker Plate Bearings and Bearing Plates for Bridges. Castings shall conform to ASTM A 48, Class 50. Castings will be machined and finished as required by the Engineer.

207.5.6 Asphalt Coating. Unless otherwise specified, castings shall be painted or dipped in commercial quality asphalt paint.

207.6 BRONZE OR COPPER ALLOY CASTINGS.

207.6.1 General. Bronze and copper alloy castings shall be true to pattern in form and dimension and free from defects that would affect the service value of the casting. Minor defects may be repaired with the approval of the Engineer. Castings which have been repaired without the permission of the Engineer may be rejected.

207.6.2 Testing Requirements. Chemical analysis shall be made in accordance with ASTM E 54.

207.6.3 Expansion and Bearing Plates. Bronze expansion and bearing plates shall conform to the requirements of ASTM B 22, Alloy 911. Copper alloy bearing plates shall conform to ASTM B 100, Alloy 510. The sliding contact faces will be machined smooth to true planes. If practicable, one plate will be machined at right angles to the other plate in the set.

207.6.4 Ornamental Tablets and Miscellaneous Castings.

207.6.4.1 General. Bronze ornamental tablets, railings, miscellaneous ornaments and fixtures shall conform to

the chemical requirements of ASTM B 143, Alloy 1B.

207.6.4.2 Ornamental Tablets. The letters shall be heavily raised and spaced carefully to secure a uniform and balanced effect over the entire area of the panel. The background of the letter panel shall have a finely pebbled surface. The model of the tablet will be submitted to the Engineer for approval before castings are made.

Castings will be boldly filleted at angles, and the arrises will be sharp and true. The faces and edges of all lettering and ornaments shall be tooled sharp and clean. Beveled edges shall be tooled smooth and true. Outside borders shall be straight and true and will be thoroughly polished. Filing and other tool marks will be removed.

Ornaments, lettering, and the beveled edges will be given a fine satin hand finish. Lettering, bevels, and rosettes will be highlighted; leaves and scrolls slightly highlighted, but well polished. The pebble background will be finished in dark statuary bronze and polished.

207.7 METAL RAILINGS.

207.7.1 Metal Hand Railings. Steel railings materials shall be welded or seamless steel pipe conforming to the requirements of ASTM A 120, structural steel conforming to ASTM A 36, or tubular sections of hot rolled mild steel, conforming to ASTM A 501.

The base metal for aluminum railing shall be ASA alloy designation 6063-T6. Pipe and tubing will be extruded conforming to the requirements of ASTM B 429, plates and sheets will be rolled conforming to ASTM B 209, and rods, bars or shapes shall be extruded conforming to ASTM B 221.

207.7.2 Highway Guard Rail shall be corrugated sheet steel beams as detail on drawings. The class and thickness will be as specified on the drawings. All guard rail elements, terminal sections and fittings will be interchangeable with similar parts, regardless of source or manufacturer. Guard rail, terminal sections and appurtenances will be in accordance with AASHTO M-180, the drawings and the following.

Beams shall be Class B with buffer and sections being either Class A or B. Beams will be galvanized after fabrication with a Type 1 or 2 coating in accordance with AASHTO M-180.

207.7.3 Guard Rail Posts and Blocks. Railing posts shall be either wood, steel or concrete as specified. When the choice of posts is contractor's option, there shall be only one kind furnished on the project. Spacer blocks will be wood.

207.7.3.1 Wood posts shall be treated Southern Pine or Douglas Fir in accordance with Subsection 205.1 and 205.2.

207.7.3.2 Steel posts shall be of the section and length specified and conforms to ASTM A-123. Posts will be galvanized in accordance with ASTM A-123.

207.7.3.3 Precast concrete posts will conform to Section 603 and the following. Compressive strength will be 3000 psi min. at 28 days. Aggregate gradation will be optional with the contractor. Posts shall be given a Class I, ordinary finish in accordance with Subsection 601.8.

207.7.4 Guard Rail Hardware. Splices, end connections, and anchor rods and accessories shall be of the type and design specified or indicated on drawings and shall be of such strength as to develop the full design strength of the rail elements.

Bolts and nuts will conform to ASTM A-307. All fittings, bolts and other accessories for steel guard rail will be galvanized, after fabrication, in accordance with ASTM A-123 or A-153.

207.7.5 Wire Rope Guard Rail. Wire rope or wire cable and fittings shall conform to AASHTO M-30. Flexible rail elements composed of multiple wires in any arrangement other than rope form shall conform to

drawing details and strength requirements for the item.

207.8 CHAIN LINK FENCE.

207.8.1 General. All materials and fittings shall be new, and all ferrous materials shall be galvanized in accordance with following specifications. The base material for the manufacture of steel pipe used for posts, braces, top rail, and gate frames will conform to the requirements of ASTM A-120, and the base material for the manufacture of other steel sections used for posts and braces will be commercial quality, weldable steel. Components for commercial and residential grades of fence shall be identical except where specified otherwise hereinafter. All material shall be furnished in a commercial grade unless indicated to be residential on the drawings.

207.8.2 Galvanizing. Ferrous metal elements of fence and gates shall be zinc coated by hot dip process after fabrication. Galvanizing for wire fabric shall comply with ASTM A-392 Class I, 12. oz. zinc, per sq. ft. (.37 kg/sq. m) of wire surface area.

207.8.3 Fabric shall be helically wound and interwoven from No. 9 gauge for commercial grade, 11 gauge residential grade steel wire to form a continuous chain link fabric having a 2" (50.8 mm) mesh, top edge barbed, bottom edge knuckled.

207.8.4 Line Posts shall be steel pipe, 2 $\frac{3}{8}$ " (50.8 mm) OD weighing 3.65 lbs. per lin. ft., (5.43 kg/m).

207.8.5 Gate Posts. Up to 6' (1.8 m) wide shall be 2 $\frac{7}{8}$ " (63mm) OD steel pipe weighing 5.79 lbs. per lin. ft. (8.62 kg/m). 6' (1.8 m) to 13' (3.8 m) wide; 4" OD steel pipe, 9.11 lbs. per lin. ft. (13.56 kg/m). 13' (3.8 m) to 18' (5.4 m) wide: 6 $\frac{5}{8}$ " (15.3 cm) OD steel pipe, 18.97 lbs. per lin ft. (28.23 kg/m).

207.8.6 Corner Posts. Steel pipe, 2 $\frac{7}{8}$ " (63 mm) OD weighing 5.79 lbs. per lin. ft. (8.62 kg/m).

207.8.7 Top Rail. Steel pipe, 1 $\frac{5}{8}$ " (32 mm) OD, 2.27 lbs. per lin. ft. (4.05 kg/m).

207.8.8 Fabric Ties. No. 9 galvanized wire of approved design for use on line posts every 14" (36 cm). Provide No. 9 bottom tension wire, galvanized pig rings at 12" (30 cm) o.c.

207.8.9 Tension Bars. $\frac{3}{16}$ " x $\frac{3}{4}$ " (4.7 mm x 19.0 mm) high carbon steel attached to terminal posts by means of beveled edge bands, for attaching fabric to terminal posts.

207.8.10 Intermediate Post Tops. Malleable iron, designed to fit over post to exclude moisture from inside of pipe and for use with top rail.

207.8.11 Gate, End and Corner Post Tops. Malleable iron, designed to exclude moisture.

207.8.12 Bracing for End, Corner and Gate Posts. Corner posts shall be furnished with two brace assemblies, and end and gate posts: furnished with one brace assembly. A brace assembly will consist of a single piece horizontal member, of 1 $\frac{7}{8}$ " (48.3 mm) outside diameter steel pipe weighing 2.72 pounds per foot (4.05 kg/m), and a $\frac{3}{8}$ " (9.53 mm) diameter steel rod with drop forged turnbuckle for use as a diagonal tension member.

207.8.13 Gate Frames. 2 $\frac{3}{8}$ " (50.8 mm) outside diameter steel pipe weighing 3.75 pounds per foot (4.05 kg/m), securely braced and pipe and an adjustable truss rod not less than $\frac{3}{8}$ " (9.53 mm) diameter.

207.8.14 Gate Fittings.

- (a) Hinges - Double clamping offset type of malleable iron, designed to permit a swing of 180°

- (b) Latches - For double gate latches, will be of an approved eccentric double locking type which engage strikes bolted to gate frame at top and bottom, with lever handle of drop forged steel, and with lock bars which shall engage a malleable iron gate stop. For single gate latches, will be approved type of positive latching device of the forked latched type. All latches will be so designed as to be readily locked with a padlock.
- (c) Keeper - Each gate frame will be furnished with a keeper which automatically engages the gate frame when swung open and holds it in open position.

207.8.15 Barbed Wire Supporting Arm. Pressed steel, wrought iron or malleable iron with provision for attaching 3 rows of wire to each arm. Provide single 45° arm for each post.

207.8.16 Barbed Wire. Four point pattern, No. 1 $\frac{1}{2}$ gauge steel wire with barbs spaced 3 in. (7.7 cm) apart.

207.9 MAST ARM POLE ASSEMBLY FOR STREET LIGHTING AND TRAFFIC SIGNALS.

207.9.1 General. All mast arm pole assemblies, as supplied, must conform to the detailed and/or the requirements on the Drawings as to height, general design and finish. The pole assembly will consist of a steel shaft and either one or two signal mast arm assembly as shown in the plans. When shown in the plans, the pole assembly will also include a luminaire mast arm. Assemblies of designs similar to those shown in the plans but which have a different cross-sectional configuration or dimensions in the signal arm or shaft shall be deemed acceptable unless otherwise specified and after review by the Engineer.

207.9.1.1 Design Loads. The pole assembly shall be designed to support a 100-pound (45 kg) load with 12 square feet (1.115 sq. m) of signal head and sign area rigidly mounted at the end of the signal mast arm and a 75 pound (34 kg) load with 3.1 square feet (.288 sq. m) of luminaire area rigidly mounted at the end of the luminaire mast arm, simultaneously with wind loading specified in Subarticle 207.9.1.2.

207.9.1.2 Wind Loads. In addition to dead loads specified above and weights of arms and shaft, each assembly will be designed to withstand wind and ice loads on the specified signal head, sign and luminaire areas, and on all surfaces of the support, in accordance with the American Association of State Highway & Transportation Officials "Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals" and other specifications of this body as may be pertinent. Unless otherwise shown in the plans, wind speeds used for design will be based on a 50-year mean recurrence interval.

207.9.1.3 Allowable unit stresses in each component of the assembly will be as provided in the AASHTO Specifications mentioned in Subarticle 207.9.1.2.

207.9.1.4 Fabrication. Pole assemblies required to be hot-dip galvanized shall be so designed as to provide proper fillings, venting and draining during the cleaning and galvanizing operations. All casting shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blowholes and other defects in positions affecting their strength and value for the service intended. No sharp unfilleted angles or corners will be allowed. The surface will have a workmanlike finish.

All parts of the same type (including mast arms of the same length) will be interchangeable.

Unless otherwise specified, the wind drag coefficient will be 1.2.

207.9.2 Shaft.

207.9.2 General. The shaft shall be fabricated to satisfy the strength requirements of Subarticle 207.9.1.1. A welded joint will develop the full required strength of the welded member.

207.9.2.2 Fabrication Requirements. Round continuous Tapered Tube -The shaft shall have no more than two longitudinal welded joints and shall have no more than two horizontal welded joints above the shaft base. The

steel shall meet the strength requirements of Subarticle 207.9.1.1. After forming and welding, the tapered shaft may be longitudinally rolled under sufficient pressure to flatten the weld. The metal shall meet the strength requirements of Subarticle 207.9.1.1. The longitudinal and horizontal welds will be smooth so as to obtain the appearance characteristics of the pole itself. The tube taper will be .14 in. per ft. (119 mm/m).

When a luminaire mast arm is called for or shown on the plans, a slip-on or bolt-on shaft extension of suitable design will be accepted in lieu of a continuous (welded or one length) shaft.

207.9.3 Shaft Base. A fabricated steel base shall be constructed with an opening of a size and shape to receive the shaft and will be welded to the end of the shaft by continuous welds. The base and welds shall be such to develop the strength of the adjacent shaft section. Four anchor rods and four nuts will be provided in accordance with Subarticle 207.9.6.

207.9.4 Handholes. Reinforced handholds with covers shall be furnished of size and locations as shown on the drawings. Covers will be attached by screws that are either stainless steel or galvanized. A 20-section terminal block shall be located in the hand hole for field wiring purposes.

207.9.5 Signal and Luminaire Mast Arm Assemblies. Each mast arm assembly shall be of steel and shall be of the type design as is shown and/or is described in the plans. The mast arm assembly designs and hardware attachments shall meet the requirements designated in Subarticle 207.9.1.2.

A single signal mast arm assembly shall be fastened to the shaft assembly by connector bolts, by U-bolts, or by other means accepted by the Engineer. The second signal mast arm shall be fastened by U-bolts or other means accepted by the Engineer. The second signal mast arm shall be able to be rotated independent to the rotation of the other mast arm as called for in Subarticle 207.9.1.2.

The luminaire mast arm if called for shall be fastened to the shaft assembly by a simplex fitting assembly. The luminaire mast arm, after the luminaire is attached, shall be able to sustain a vertical load of 200 pounds (90 kg) applied at a point of luminaire attachment without failure or apparent permanent deformation of the luminaire arm. The luminaire end of the mast arm shall be formed to accommodate a 2" (50.8 mm) slipfitter. Fastening the mast arm assemblies to the shaft by use of set screws (which would cut into or groove the shaft) guys, rods or sway braces shall not be acceptable.

207.9.6 Anchor Bolts. Four steel anchor bolts shall be furnished for each pole assembly. The allowable unit stress for each anchor bolt shall be as provided in the AASHTO Specifications mentioned in Subarticle 207.9.1. Each anchor bolt shall be threaded at the top and fitted with two nuts and two flat washers. The embedded end of the bolt shall have a standard nut, head or 90° bend or an equivalent or better device as may be approved. The anchor bolt material shall have a minimum elongation in 2 inches (50.8 mm) of 16% or in 8 inches (201.6 mm) of 14%.

207.9.7 Finish.

207.9.7.1 General. The steel mast arm pole assembly shall be provided with a galvanized finish.

207.9.7.2 Hot-Dip Galvanizing. The complete standard, with the exception of the standard length galvanizing on the anchor bolts, including all parts used in the assembly shall be completely hot-dipped galvanized after fabrication in accordance with ASTM Designation: A 123. All screws, nuts, bolts, washers, and at least the upper 9 inches of the anchor rods shall be galvanized in conformance with the specifications of ASTM Designation: A 153, Class C or D unless otherwise specified. All threaded material shall be brushed or recapped after galvanizing.

Any part of steel mast arm pole assembly from which the galvanizing has been knocked or chipped off down to bare metal in fabrication, transit or erection, shall be repaired by application of galvanizing - repair compounds meeting Federal Specification 0-G-93 (Stick Only) or ZRC Cold Galvanizing Compound, Zinc-rich coating (96% zinc) in accordance with the manufacturer's recommendations. The galvanizing repair shall be applied so as to provide a pole assembly which is neat in appearance.

SECTION 208

STORM DRAIN PIPE

208.1 STORM DRAIN PIPE.

208.1.1 Non-reinforced Concrete Pipe.

208.1.1.1 General. Concrete pipe shall conform to ASTM C14 and shall be Class III unless otherwise specified, shall be manufactured from Portland cement concrete. The plane of the ends of the pipe, except for special shapes, shall be perpendicular to the longitudinal axis of the pipe. The interior surface shall be smooth and well finished. Joints shall be either of the socket and spigot type or the tongue and groove type, as approved by the Engineer, and so constructed that, when laid, the pipe will form a continuous conduit with a smooth and uniform interior surface.

When shown on the plans, the pipe shall have a gasketed joint. The gasket shall be seated in an accurately shaped groove on the spigot and of the pipe section and the gasket shall be of suitable cross section and size to fill the groove and provide a water-tight joint when the pipe is laid. Alternate joint details may be used if approved by the Engineer. The gasket shall be manufactured from a synthetic rubber of neoprene base and shall conform to the requirements of ASTM C443.

The completed pipe shall be free from fractures, large or deep cracks, laminations, and surface roughness. Specimens which, when placed in a vertical position, do not give a metallic ring when struck with a hammer, or exhibit any of the defects listed as causes for rejection in ASTM C14, will be subject to rejection.

208.1.1.2 Dimensions. Each straight pipe of all sizes and classes shall be not less than 3 feet (0.91 m) in length unless otherwise specified for special purposes. The minimum length of 6 inches (152 mm) Wyes and Tees shall be 18 inches (.457 m) and 24 inches (610 mm) for 8 inch (203 mm) and larger Wyes and Tees. Other dimensions of pipe shall conform to ASTM C14.

208.1.1.3 Marking. Each pipe shall be marked clearly and legibly to show the class of pipe, the date of manufacture, and the name or trade mark of the manufacturer.

208.1.1.4 Test Requirements. When required by the Engineer the following tests shall be performed. Before pipe is delivered to the job site for use in any work, test pipe shall meet the requirements of the loading test described herein. The tests shall be made at the point of manufacture and shall be made under the supervision of the Engineer.

The Engineer will select at random and have tested one pipe for each 100 Pipes or fraction thereof in each lot.

The contractor shall furnish the test pipes without charge and shall provide adequate equipment and facilities for conducting tests. Unless otherwise specified, the contractor shall bear all costs involved in testing.

208.1.1.4.1 Loading Test. The loading test shall be the 3-edge bearing conforming to ASTM C14. Pipe shall withstand the loads as indicated in ASTM C-14 for the class of pipe specified.

208.1.2 Reinforced Concrete Pipe.

208.1.2.1 General. These specifications apply to reinforced concrete pipe intended to be used for the construction of storm drains, sewers, and related structures. Reinforced concrete pipe shall conform to ASTM C76 amended as follows:

- a. Unless otherwise specified, Class III Reinforced Concrete Pipe, Wall A, B or C (Table 3) shall be furnished.
- b. When extra strength pipe is required, Class IV Reinforced Concrete Pipe, Wall A, B or C (Table 4) shall be furnished.

The pipe shall be tested for permeability as specified in ASTM Designation: C14. Frequency of testing shall be a minimum of one pipe per lot of sizes up to and including 48 inches (1.2 m) in diameter and not to exceed one test per 1000 joints of pipe manufactured. The absorption test specified in ASTM Designation: C76 will be conducted at the discretion of the Engineer in cases where the pipe exhibits visual porosity.

208.1.2.2 Joints. Unless otherwise indicated on the Drawings, joints shall be of the tongue-and-groove or bell- and - spigot type containing one of the following type of gaskets. Type of gasket used shall be at contractor's option unless otherwise directed by the Engineer.

208.1.2.2.1 Gasket. - "O Ring". A confined "O Ring" flexible water tight gasket conforming to AASHTO M-198, Type A or B.

208.1.2.2.2 Gasket. - Rope Form. A preformed plastic sealing compound manufactured for pipe joints conforming to Fed. Spec. SS-S-00210, Type I.

208.1.2.2.3 Gasket. - Flexible plastic gasket conforming to AASHTO Designation M-1980-75 Type B.

208.1.2.2.4 Priming of the Joints. - Joints shall be primed.

208.1.2.3 Methods of Acceptance. Basis of acceptance shall be in compliance with ASTM C76.

208.1.2.3.1 D-Load Bearing Strength Method. The Engineer will select at random, at the point of manufacture, any number of lengths of pipe up to one length per hundred lengths from each run of pipe to be used for special testing to destruction in addition to the routine tests made under ASTM Specifications.

The required number of test specimens and the test pipe shall conform in all respects to the applicable requirements of ASTM C-76. The pipe shall be tested by one of the two standard methods of testing; namely, (a) the 3-edge bearing, (b) the sand bearing as prescribed in ASTM C-76, and the required strength of the pipe specimens undergoing the bearing tests shall conform with the D-load requirements designated herein.

208.1.2.3.2 Structural Design Method. Where structural details of the pipe are shown on the drawings, the manufacture of pipe shall be checked by making the appropriate tests on the concrete placed in the pipe forms, by inspection of the steel reinforcing cages that are to be used in the pipe, and by inspection of the fabrication of the pipe.

208.1.2.3.3 Stockpiled Pipe. Stockpiled pipe may be used when approved in advance by the Engineer and provided the pipe meets all other specified requirements. For the purpose of these specifications, "stockpiled" pipe shall be defined as pipe manufactured in quantity, which will meet requirements of this section, but which was not manufactured for use in specific projects; however, pipe which has been rejected by another agency will not be considered as "stockpiled" pipe, nor will such pipe be accepted.

208.1.3 Reinforced Concrete Pressure Pipe.

208.1.3.1 General. These specifications apply to three types of reinforced concrete pressure pipe, two of which are not prestressed and one prestressed, with internal diameters of 12 inches (305 mm) and

larger; and to be used in the transmission and distribution systems that carry water under pressures specified on the plans.

208.1.3.2 Manufacture and Tests. Reinforced concrete pressure pipe and fittings shall be manufactured and tested to conform to one of the following specifications:

- a. AWWA C300 for the steel bar-reinforcement and cylinder type in pipe diameters of 24 inches (610 mm) and larger, for design pressure of 40 psi to 260 psi (276kPa to 1793kPa), and for external loading conditions as may be designated on the Drawings.
- b. AWWA C301 for the prestressed steel wire-reinforcement and cylinder type, in pipe diameters of 30 inches (762 mm) and larger, for design pressures to a maximum of 350 psi (2413kPa), and for external loading conditions as may be designated on the Drawings.
- c. AWWA C302 for the steel bar reinforcement (without cylinder) type, in pipe diameters 12 inches (305 mm) and larger, for design pressures of not more than 45 psi (310kPa), and for external loading conditions as may be designated on the Drawings.

208.1.4 Perforated Concrete Pipe. Perforated concrete pipe shall conform to the requirements of ASTM C-444, Type 2 and all applicable requirements of ASTM C14, Class 2.

208.1.5 Concrete Drain Tile. Concrete Drain Tile shall conform to ASTM C412 Standard Quality unless specified otherwise on the Drawings.

208.1.6 Reinforced Concrete Arch Pipe. Reinforced concrete arch pipe shall conform in all respects to ASTM C-506, Class II, III, or IV. The size and specific load bearing class shall be as required by the Drawings or the Engineer. Unless specified otherwise, Class III shall be used.

208.1.7 NOT USED.

208.1.8 NOT USED.

208.1.9 NOT USED.

208.1.10 Structural Plate for Pipe, Arches, and Pipe Arches.

208.1.10.1. General. Structural plate pipe, arches, and pipe arches shall be of the sizes, gages and dimensions designated on the Drawings and as specified herein.

208.1.10.2. Materials. Plates and nuts and bolts conform to the specifications of AASHTO Designation M 167. Galvanized surfaces which are damaged shall be repaired in accordance with the provisions in Subsection 210.8 "Galvanizing".

208.1.10.3. Bituminous Coating. Bituminous coating shall conform to the provisions of AASHTO Designation M 190. Damaged bituminous coatings shall be repaired by the contractor at his expense by applying bituminous material conforming to M 190.

208.1.10.4. Distortion. In advance of placing backfill material around circular structural plate pipe, the pipe shall be distorted. Distortion may be performed either at the fabricating shop or in the field. If the plates are distorted in the fabricating shop, the plates shall be distorted to provide an increase in the vertical diameter of the pipe, after assembly, of approximately 5% for the full length. Plates shall be marked in order to assure that they will be placed in proper position.

If the pipes are distorted in the field, the method of distortion shall conform to the details shown on the

plans. The vertical diameter shall be increased by the approximate percentages listed in the following table, throughout that portion of the pipe between shoulder lines.

Pipes using 1 or 3 gage top and side plates	-	1%
Pipes using 5 or 7 gage top and side plates	-	2%
Pipes using 8 or 10 gage top and side plates	-	3%

Between the shoulder lines and the outer ends of the pipe the distortion may decrease uniformly to zero.

208.1.11 Corrugated Aluminum Pipe And Pipe Arches.

208.1.11.1 General. Corrugated aluminum pipe, pipe arches, and connectors to be used or furnished shall be manufactured and inspected in conformance with the requirements of AASHTO M 196, AASHTO M 197, and as hereinafter specified. The size, type, and gage of the pipe to be furnished shall be shown on the Drawings. Corrugated aluminum pipe may be fabricated by riveting or using a helically corrugated aluminum pipe with a continuous helical lock seam paralleling the corrugations. Corrugated aluminum pipe arches shall consist of corrugated aluminum pipe which has been reformed to a multi centered pipe having an arch-shaped top with a slightly curved integral bottom.

The specifications contained herein for pipe shall also apply to pipe arches. Nominal diameter of dimensions as referred to in AASHTO M 196 and M 197 shall be defined as meaning the minimum inside dimension of the pipe.

208.1.11.2 Materials. Corrugated aluminum products covered by this section may be fabricated of the kind of base metal listed in M 196 and all pipe for any one continuous installation shall be fabricated of the same base metal.

208.1.11.3 Connecting Bands. The connecting bands shall conform to the requirements of AASHTO M 196, except that the minimum width of band for helical pipe shall be 12 inches (305 mm). The connecting bands shall be the same base metal as the pipe. The gage of the connecting bands for pipe arches and helically corrugated pipe shall be the same as for an equivalent diameter of circular pipe. The band couplers shall be connected with galvanized steel bolts of not less than B inch (13 mm) diameter.

208.1.11.4 End Finish. If head walls or flared end sections are not being provided and if called for on the plans or in the Special Provisions, the inlet and outlet of all culverts fabricated of 16 or 14-gage sheets shall be reinforced. The reinforcement shall consist of an aluminum rod not less than 7/16 inch (11.1 mm) in diameter rolled in the sheet, or by an aluminum band equivalent in cross section to 3/8 inch minimum thickness by 18 inches (9.5 mm to 38.1 mm) wide or at least the outer foot of 16-gage pipe shall be of at least 12-gage material, and the outer foot of 14-gage pipe shall be of at least 10-gage material. If a band is used, it shall be placed around the ends of the pipe and fastened with rivets or resistance spot welds at intervals of 10 inches (254 mm) or less.

208.1.11.5 Fabrication. Pipe fabricated by riveting shall conform to AASHTO M 196. Pipes fabricated with a continuous helical lock seam parallel to the corrugations shall conform to the requirements of AASHTO M 197 for Type I without perforations and as specified herein.

208.1.11.6 Bituminous Coating. When required by the Special Provisions, pipes and connecting bands shall be protected, both inside and outside, with a bituminous coating. The bituminous coating shall conform to the requirements of AASHTO M 190 and as hereinafter specified.

The minimum thickness of bituminous material for all coated pipe measured on the crests to a minimum depth of 1/8 inch (3.2 mm), and the width of Paving shall at least cover 1/3 of the periphery of pipe arches and 1/4 of the periphery of circular pipes. When corrugated aluminum pipes are to be bituminous coated,

the fabrication requirements specified in AASHTO M 196 shall be altered so that the rivet heads inside the pipe will be in the valley of the corrugations.

208.1.12 ABS Solid Wall Pipe.

208.1.12.1 General. Pipe, fittings and joints shall comply with ASTM D2751 except as modified herein. Joint solvent cement shall be an ABS cement conforming to ASTM D2235. Gaskets shall conform to the requirements of ASTM C443, Section 4 for rubber or synthetic rubber composition.

208.1.12.2 Pipe Acceptance. At the time of manufacture, each lot of pipe and fittings shall be inspected for defects, and tested for impact, stiffness and flattening in accordance with ASTM D2751. The Engineer may require certification by the manufacturer that the test results comply with specification requirements.

208.1.12.3 Marking. Pipe shall have a home mark to indicate full penetration of the spigot when the joint is made. Pipe shall be marked at 5 feet (1.5 m) intervals or less with a marking number which identifies the manufacturer, SDR, and size of pipe.

208.1.13 ABS Composite Pipe

208.1.13.1 General. Pipe, fittings and joints shall comply with ASTM D2680, except as modified herein. The pipe shall consist of two concentric extruded thermoplastic tubes integrally connected by webs to form a circular truss. The longitudinal void spaces shall be filled with inert material.

Joint solvent cement shall be an ABS cement conforming to ASTM D2235. Gaskets shall conform to ASTM C443, Section 4 for rubber or synthetic rubber composition.

208.1.13.2 Pipe Acceptance. Each lot of pipe and fittings shall be inspected for defects and tested for stiffness and deflection in accordance with ASTM D2680. The Engineer may require certification by the manufacturer that the test results comply with specification requirements. A pipe lot shall consist of all pipe having the same marking number. The lot test specimen shall be a minimum length of 4 feet (1.2 m).

208.1.13.3 Marking. Pipe shall have a home mark to indicate full penetration of the spigot when a joint is made. Pipe shall be marked at 5 feet (1.5 m) intervals or less with a marking number which identifies the manufacturer and size of pipe.

208.1.13.4 Repair. There shall be no discontinuity of the pipe inner wall. Ruptures in the pipe outer wall may be repaired if the damage is limited to an area that can be encompassed by a 3 inch (76.2 mm) diameter circle superimposed over the damage. Cell filler repair is unnecessary. A solvent welded ABS repair patch, at least equal to the thickness of the pipe outer wall, shall extend at least 1 inch (25.4 mm) beyond the damage. When damage exceeds these limits, the damaged section shall be cleanly cut off the pipe.

208.1.14 Corrugated Steel Pipe And Pipe Arches.

208.1.14.1 General. Corrugated metal pipe, pipe arches and connectors shall be manufactured and inspected in conformance with AASHTO M 36 and as specified herein. The size, type, coating, and gage of the pipe to be furnished shall be as shown on the Drawings. Corrugated metal pipe arches shall consist of corrugated metal pipe which has been re-formed to multi-centered pipe, having an arch-shape top with a slightly curved integral bottom. Nominal diameter as referred to in AASHTO M 36 shall be defined as meaning the minimum inside dimension of the pipe.

208.1.14.2 Materials. Corrugated metal products provided for by this subsection may be fabricated of any of the base metals listed in AASHTO M 218 or ASTM A596 with 0.20% min. copper added. All pipe for each installation shall be fabricated from the same base metal.

208.1.14.3 Connecting Bands. The connecting bands shall conform to the requirements of AASHTO M36, except that the minimum width of the bands for pipe ends with annular and helical corrugations shall be 10 inches (254 mm) and 12 inches (305 mm), respectively, for pipe diameter 18 inches (457 mm) and larger. The connecting bands shall be the same base metal as the pipe and shall be galvanized.

The connecting bands shall have corrugations that mesh with the corrugations of the pipe and shall be connected at the ends by galvanized angles. Connecting bands less than 12 inches (305 mm) in width shall be connected by at least two galvanized bolts not less than B inch (12.7 mm) diameter. Bands 12 inches (305 mm) or greater in width shall have at least three B inch (12.7 mm) diameter galvanized bolts. Other equally effective types of connecting bands may be used if approved by the Engineer.

When watertight joints are specified on the Drawings the connecting bands shall be placed over a 1/4 inch (6.4 mm) thick neoprene gasket, O-ring type gasket, or a 1/4 inch layer of asbestos fiber asphalt caulking compound, except that the O-ring type gasket shall not be used with pipes with helical ends. The O-rings shall conform to Section 5 of ASTM C443 and have a minimum cross sectional diameter of 13/16 inch (20.6 mm).

208.1.14.4 End Finish. When no head walls or flared end sections are specified on the plans, the ends of all pipes fabricated of 16 or 14-gage sheets shall be reinforced. The reinforcement at the end of the pipe shall consist of a galvanized steel rod not less than 7/16 inch (11.1 mm) in diameter rolled in the sheet, or by a galvanized metal band with a minimum cross section of 3/8 inch by 1B inch (9.5 mm by 38.1 mm) or the outer 1 foot (305 mm) of pipe shall be fabricated of 12-gage material for 16-gage pipe, and 10-gage material for 14-gage pipe. Where a band is used it shall be placed around the ends of the Pipe and fastened with rivets or resistance spot welds at intervals of 10 inches (254 mm) or less.

208.1.14.5 Fabrication. Corrugated metal pipe may be fabricated by riveting, resistance spot welding, or by using a helically corrugated metal pipe with a continuous helical lock seam paralleling the corrugations, in conformance with AASHTO M 36.

208.1.14.6 Repair of Damaged Zinc Coating. Zinc coatings which have been field or shop cut, burned by welding, abraded, or otherwise damaged to such extent as to expose the base metal, shall be repaired and recoated in accordance with Subsection 210.8.4.

208.1.14.7 Coatings.

208.1.14.8 Bituminous Coating. When required by the Drawings, pipe and connecting bands shall be protected, both inside and outside, with a bituminous coating or with a bituminous coating containing an asbestos fiber. The bituminous coating shall conform to the requirements of AASHTO M 190 and as specified herein. The minimum thickness of bituminous coating for all coated pipe shall be 0.05 inch (1.27 mm) measured on the crest of the corrugations.

For paved invert corrugated metal pipe, the bituminous material shall cover the crests of the corrugations to a minimum depth of 1/8 inch (3.2 mm) and the width of paving shall cover at least 1/3 of the periphery of pipe arches and 1/4 of the periphery of circular pipe.

The bituminous material shall conform to Paragraph 4 of AASHTO M 190.

When corrugated metal pipe is to be bituminous coated, the fabrication requirements specified in AASHTO M 36 shall be altered so that the rivet heads inside the pipe will be in the valley of the corrugation. Damaged bituminous coatings shall be repaired by the contractor at his expenses by applying bituminous material conforming to the provision in this subsection.

SECTION 209

WATER AND SEWER – PIPING AND APPURTENANCES

This specification details the material requirements for various elements of the Water and Sewer projects. This specification section shall be used in conjunction with City's Wastewater Collection specifications (Part 20), Water Distribution specifications (Part 30), and contract documents. The publications/references are referred to within the text by the basic designation only. The most recent version of these references shall apply.

209.1 WATER MAINS.

Unless specified otherwise in the contract documents, only water mains specified in this section shall be used. Only pipe materials listed in this section shall be used for main extensions unless specifically authorized in writing by the City of Shreveport. The pipe shall meet the strength requirements detailed in this section and shall be based on standard engineering design procedures and manufacturer or trades association recommendations. All pipe used in the construction of water lines shall be "Underwriters Laboratory (UL)" approved. All pipes shall be circular. Water main bedding materials shall be provided as indicated in these specifications, construction plans and/or as shown in STANDARD PLAN No 3000-1 and 3000-2. The publications/references used in this specification become a part of this specification.

209.1.1 Ductile Iron Pipe and Fittings. Ductile iron pipe must meet the latest revisions of AWWA C150, AWWA C151 and AWWA C111. Buried pipe shall be designed for a minimum pressure class of 250 psi.

209.1.1.1 Pipe Thickness. Thickness design of ductile iron pipe shall be in accordance with AWWA C150. Thickness design shall be based on a minimum working pressure of 150 psi, and Type 5 laying condition with a minimum of 5 feet of cover. Surface loading shall be AASHTO H-20 Truck.

209.1.1.2 Joints. Buried ductile iron pipe shall be push-on or mechanical joint, with factory installed rubber gasket conforming to the latest revisions of AWWA C111. Above ground piping shall have flanged joints.

Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to AWWA C115. Flange for set screwed flanges shall be of ductile iron per ASTM A536. Gasket and lubricants for set screwed flanges shall be in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111. Design of set screwed gasket shall provide for confinement and compression of gasket when a joint to adjoining flange is made.

209.1.1.3 Flanged Pipe. Flanged pipe shall comply with the latest revision of AWWA C115. Pipe barrel shall be designed in accordance with the latest version of AWWA C151. Nominal thickness of pipe shall be pressure class 250. All flanges shall be ductile iron and rated for working pressure of 250 psi.

209.1.1.4 Coating and Lining. All ductile iron pipe shall be asphaltic coated outside and cement-mortar lined inside with seal coat of bituminous material in accordance with AWWA C151 and AWWA C104 respectively.

209.1.1.5 Fittings. Fittings shall be cast of ductile iron conforming to AWWA C153. Ductile iron fittings shall be asphaltic coated outside and cement-mortar lined inside with a seal coat of bituminous material conforming to AWWA C104 latest revisions. Joints for buried ductile iron fittings shall be mechanical joint conforming to AWWA C153 and AWWA C111. Above ground fittings shall include flanged joints fittings.

Ductile Iron pipe and fittings shall be as manufactured by American, U.S. Pipe, McWane, or approved equal.

209.1.1.6 External Corrosion Protection. Special external corrosion protection shall be provided for all ductile iron pipe and fittings. Exemptions to this requirement must be approved by the Engineer. External corrosion protection shall be accomplished by complete wrapping of the pipe with 8 mil thick polyethylene immediately before installing the pipe. Polyethylene encasement material shall be in accordance with requirements of AWWA C105. The polyethylene encasement shall provide a "loose" wrap with no tears, rips or other perforations of the material.

209.1.2 Polyvinyl Chloride (PVC) Pressure Pipe. PVC Pressure Pipe shall meet or exceed AWWA C900, pressure class 235, Dimension Ratio (DR) 18 for Municipal Water Pipe sizes 8" through 12" and AWWA C905, pressure class 235 for DR 18 for Transmission Water Pipe sizes 16" through 30". Water pipe sizes 36" and above shall be pressure class 165 for DR 25 minimum. PVC pipe shall be furnished in cast iron pipe-equivalent outside dimensions. PVC Water pipe shall be listed by Underwriters Laboratories and bear the seal of approval (or "NSF" mark) of the National Sanitation Foundation Laboratory for potable water pipe.

PVC pipe and couplings shall be made from Class 12454-S4754R or 12454 virgin compounds conforming to ASTM D5260 polyvinyl chloride resin. Chemical resistance shall be equal to S4754R or S4754MR in accordance with ASTM D5260 requirements. Except for special pieces and closures, all pipe shall be furnished in lengths of twenty feet (20') plus or minus one inch.

PVC pipe shall be as manufactured by North American, JM Eagle, Diamond Pipe or approved equal.

Pipe shall be made in nominal sizes of 8, 10, 12 and 16 inches through 36 inches and shall meet dimension ratios (DR's) and physical dimensions as follows:

Table 1. PVC Pipe Thickness

Nominal Size (Inches)	O. D. (Inches)	Pressure Class 235 (DR 18) Minimum Wall Thickness (Inches)	Pressure Class 165 (DR 25) Minimum Wall Thickness (Inches)
8	9.050	0.503	-
10	11.100	0.617	-
12	13.200	0.733	-
16	17.400	0.967	-
18	19.500	1.083	-
20	21.600	1.2	-
24	25.800	1.433	-
30	32.000	1.778	-
36	38.300	-	1.532

209.1.2.1 Joints. Joints for PVC pipe shall be factory installed rubber gasket seal joints conforming to ASTM F477 requirements. Solvent-cement type joints are not acceptable. Pipe and fittings must be assembled with a nontoxic lubricant NSF tested, and certified suitable for potable water distribution by NSF. Provisions must be made for contraction and expansion at each joint. Integral bells or affixed couplings shall be tested with the pipe.

209.1.2.2 Fittings. All fittings, tees, bends, crosses, and specials used in connection with PVC pipe shall be of the same material and minimum thickness as specified for ductile iron pipe. The fittings shall be specifically made for the pipe utilized. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC pipe utilized.

209.1.3 Concrete Pressure Pipe. Concrete pressure pipe shall be allowed only if specifically called for on project drawings.

Prestressed concrete cylinder pipe (PCCP) for nominal sizes 24" and larger, shall be designed, manufactured and tested in accordance with AWWA C301, AWWA C304, and AWWA M9, latest revisions. Submittals shall document conformance with the AWWA standards above, including certification that the pipe for the specific project was manufactured, inspected and tested in accordance with those standards. Pipe shall be designed for a minimum internal operating pressure of 150 psi, a surge allowance of 40% of the operating pressure, a dead load of 5 feet of cover, a live load based on an AASHTO H-20 truck and a Type II laying condition. Pipe shall not be ordered until design calculations have been approved. The pipe shall be either prestressed concrete lined cylinder pipe (LCP) or prestressed concrete embedded cylinder pipe (ECP) depending on the pipe size. All pipe and fittings shall be approved and listed by the Underwriter's Laboratories, Inc. Identification marking for pipe and fittings shall include the pressure rating.

Bar-Wrapped Concrete Cylinder Pipe for nominal sizes 24" and larger, shall be designed, manufactured and tested in accordance with AWWA C303 and AWWA M-9 Concrete Pressure Pipe, latest revision. The pipe shall be mortar lined, and mortar coated for corrosion protection.

Submittals shall document conformance with the AWWA standards above including certification that the pipe for the specific project was manufactured, inspected and tested in accordance with those standards. Bar-Wrapped Pipe shall be designed for a minimum internal operating pressure of 150 psi, a surge allowance of 50% of the operating pressure, safety factor of 2.0 for yield strength of steel, a dead load of 5 feet of cover, a live load based on an AASHTO H-20 truck and a Type II laying condition.

All pipe and fittings must meet the requirements of NSF/ANSI Standard 61. The pipe manufacturer shall have a successful experience record in the design and manufacture of concrete cylinder pipe, and shall have a substantial footage of pipe of similar size and with the same joint as offered for this project in successful operation for at least ten (10) years.

Unless otherwise noted, water main plans have been designed using ductile iron pipe. If concrete pipe is used per project drawings, the Contractor shall furnish equivalent fittings or a combination of fittings to match those specified or shown. Methods for tying pipe joints, anchorage and special backing shall be submitted to the Engineer for approval before installation.

Bevel pipe, outlet connections on straight pipe, closure pipe assemblies and other accessories required for prestressed concrete cylinder water pipe may not necessarily be called out on the drawings, but shall be furnished as required to satisfactorily install the new water main as shown on the plans. Payment for these piping items shall be included in the unit price bid for furnishing and laying the concrete pipe and fittings.

Prior to the start of the work, five (5) copies of a tabulated layout and laying schedule along with pipe design calculations prepared by a Professional Engineer licensed in the state of Louisiana shall be furnished by the Contractor to the Engineer. The Contractor shall be responsible for the completeness and accuracy of the laying schedule confirming to the contract documents. The Contractor shall also provide additional bevel adapters and short lengths of pipe to permit field adjustment of the alignment.

Acceptable manufacturers include Hanson Pressure Pipe, Vianini, Ameron, or approved equal.

209.1.3.1 Joints. Prestressed concrete cylinder pressure pipe joints shall contain steel bell and spigot rings, installed with solid-ring rubber gaskets, properly cleaned and lubricated to secure a water tight joint. The pipe shall be horizontally pushed into place using manufacturer recommended joint stoppers and the factory supplied feeler gauge to check for proper joint installation. The gasket from an improperly sealed joint shall not be reused. Damaged bell or spigots shall be rejected and removed from the project site.

Bell and spigot joint rings for bar-wrapped concrete cylinder pipe shall be steel, self-centering type, and as specified in AWWA C301, AWWA C303. In areas of the alignment where the pipe will be subject to unbalanced hydrostatic thrust forces (bends, tees, bulkheads, wyes, and valves), the pipe joints shall be mechanically restrained (harnessed) in conformance with AWWA M9. The pipe shall be horizontally pushed into place using manufacturer recommended joint stoppers and the factory supplied feeler gauge to check for proper joint installation. The gasket from an improperly sealed joint shall not be reused. Damaged bell or spigots shall be rejected and removed from the project site.

209.1.3.2 Fittings. All fittings and specials shall meet the requirements of AWWA C301 and AWWA M-9, made integrally with the pipe as required by the Engineer. Flanged outlets with blind flange covers shall be furnished complete with flange, gaskets, nuts and bolts. Mechanical joint bell outlets shall be furnished complete with gland, T-bolts and nuts. The pipe supplier shall furnish all necessary accessories when restrained joints are required. Bevels not in excess of 4½ degrees may be installed to accommodate long radius curves.

209.1.3.3 Joint Finishing. The joint shall be finished as per manufacturer's recommendations using a "diaper" strapped to the outside of the completed pipe joint, followed by a grout mixture of the required consistency poured into the opening of the diaper at the top to completely fill the external joint recess. The grout shall be rodded to insure a complete filling of the joint.

209.1.3.4 Tapping. Tapping prestressed concrete cylinder pipe shall be performed using tapping assemblies and methods as per manufacturer's recommendations.

209.1.4 High Density Polyethylene (HDPE) Pressure Pipe. HDPE Pipe in accordance to these specifications shall be used in Horizontal Directional Drilling installations. HDPE Pressure Pipe shall meet or exceed the requirements of AWWA C906 with standard Ductile Iron OD Pipe Sizing (DIPS), a working pressure rating of 160 psi and a DR of 11 for municipal water main sizes 8" through 24". HDPE water pipe shall be listed by the NSF as an approved potable water pipe, and shall be in compliance with requirements of NSF Standards #14 and #61.

HDPE pipe shall be made from polyethylene resins that meet or exceed the requirements of ASTM Material Designation Code PE 3408 resin with PE 3344334 C, D, or E cell classification. The polyethylene resins shall also meet or exceed the requirements of ASTM D 3350 cell classification 345464C. Accepted manufacturers include JM Eagle, National Pipe, Uponor Infra (KWH Pipe) or approved equal.

209.1.4.1 Joints. Joints for HDPE pipe shall be heat fusion joints conforming to ASTM D 2657 requirements. Joining to ductile iron pipe or fittings or PVC pipe shall be accomplished using mechanical joint adapters (Harvey Adapters). Mechanical joint adapters must be complete with stainless steel ID stiffeners.

209.1.4.2 Fittings. All fittings used in connection with HDPE pipe shall be ductile iron conforming to AWWA C153. Joints for cast iron fittings shall be mechanical joint conforming to AWWA C111, unless otherwise approved. Fittings shall be connected to HDPE pipe using Harvey adapters.

209.1.5 Steel Pipe (for Water Transmission Lines Larger Than 48" in Diameter). All steel pipe and fittings shall be furnished by manufacturers who are fully experienced, reputable, and qualified in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with all standards as applicable. All steel pipe, fittings, joints, etc. for installation shall be manufactured at one location unless otherwise approved.

Steel pipe shall be designed in accordance with AWWA M11 and be manufactured in accordance with the requirements of AWWA C200. Pipe shall be designed to the cover conditions as shown in plans. Modulus of soil reaction (E') values to be used for design shall be 1,000 psi for covers up to 10 feet, 1,200 psi for 10-15 feet of cover and 1,300 psi for 15-20 feet of cover. The allowable deflection shall be 3% of the pipe

inside diameter for pipe with flexible coating and 2% for pipe coated with cement mortar. Manufacturer's requirements shall be adhered to for use with couplings, trimming, etc.

209.1.5.1 Coatings and Linings. Coatings and linings shall be applied in accordance with AWWA C205, AWWA C209, AWWA C222, AWWA C602.

209.1.5.2 Fittings. Fittings shall be fabricated in accordance with AWWA C200 Section 4, from pipe conforming to applicable standards.

Fittings shall conform to the dimensions of AWWA C208 or shall be fabricated into standard or special pipe lengths as required for the project. Elbows shall have a minimum radius of 2 ½ times the pipe O.D. All tees, laterals and outlets shall be reinforced in accordance with AWWA M11.

209.1.5.3 Joints. Unless otherwise specifically noted on the drawings, the following requirements shall be met:

209.1.5.3.1 Gasketed Joints. Gasketed joints shall conform to AWWA C200 and be rolled groove type. Rolled groove gasketed joints shall consist of a flared bell end formed and sized by the use of a segmental expander or by forcing the pipe end over a plug die. The spigot end groove, designed to retain the rubber gasket shall be formed and sized by rolling on male-female dies to match the bell. The difference in diameter between the I.D. of bell and the O.D. of the spigot shoulder at point of full engagement shall be no more than 0.04 inches as measured circumferentially, with allowable deflection.

The joint shall be suitable for the pressures of the class of pipe on which it is furnished, and shall operate satisfactorily with a deflection, the tangent of which is not to exceed 0.75 inch/D where D is the outside diameter of the pipe in inches or a with a uniform pull-out of ¾ inch.

Rubber gasketed joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure, pipe diameter, pipe length, and wall thickness.

Shop applied coating shall be as recommended by the manufacturer. For gasketed joints, the exposed surfaces of the bell and spigot shall be painted with one shop coat of a holding primer.

209.1.5.3.2 Welded Lap Joints. Field welded lap joints shall be used where restrained joints are indicated on the plans and for all pipe sizes over 72 inch diameter or working pressures greater than 250 psi.

The bell shall provide for a nominal lap such that the minimum engagement, with 1 inch allowable pull, is at least 1 inch or three times the thickness of the bell, whichever is greater. Shop applied lining and coating shall be continuous and allow for welding of the joint.

209.1.5.3.3 Couplings. Couplings where indicated on the plans shall be Victaulic Depend-O-Lok, Smith Blair, Baker or equal. Couplings for buried service shall have all metal parts painted with epoxy paint conforming to AWWA C210 or C213.

209.1.5.3.4 Flanges. Flanges shall be in accordance with AWWA C207 based on the pressures and sizes of the pipe. Bolts and nuts for flanges located indoors and in enclosed vaults and structures shall be carbon steel, in accordance with AWWA C207. Bolts and nuts for buried and submerged flanges and flanges located outdoors, above ground or in open vaults in structures shall be Type 316 stainless steel.

209.2 SERVICE LINES.

209.2.1 General. The service line is the line from the water main to the customer's meter. It shall consist of the corporation cock or stop at the main, the tubing or pipe and the curb stop at the terminal end.

209.2.2 Materials.

209.2.2.1 Service Lines up to Two inches. Copper tubing shall be used for all water service lines three quarters of an inch (3/4") through two inches (2") in diameter. All copper service lines three quarters of an inch (3/4") through one inch (1") shall be domestic "Type K," soft annealed; one and a half inches (1 1/2") through two inches (2") may be soft annealed or hard "Type K" conforming to Standard Specification for seamless copper water tubing, ASTM Designation B-88 and Federal Specifications WW-T-799. The three quarters of an inch (3/4") through one inch (1") tubing shall be supplied in sixty foot (60') rolls, whereas the one and a half inches (1 1/2") to two inches (2") tubing shall be in forty foot (40') rolls or twenty foot (20') lengths. Service lines shall be one (1) solid piece of copper. No couplings shall be used on new water service lines of three quarter inch (3/4") through one inch (1") diameters.

209.2.2.2 Service Lines Larger than Two inches. Material requirements for water service lines larger than two inches (2") in diameter shall be the same standard as for municipal water mains herein. The contractor must request written approval from the City Engineer before using alternative materials.

209.2.2.3 Fittings. Stops and fittings shall be of the size and type specified, with all parts constructed of fusion bonded, nylon coated, stainless steel and/or of brass conforming to Copper Alloy UNS No. C89833 (No Lead) per ASTM B584. All stops, cocks and fittings shall be full size openings throughout, of the size specified. All castings shall be smooth, free from burrs, scales, blisters, sand holes and defects of any nature, which would make them unfit for the use for which they are intended. Operating nut shall be smooth cast, with symmetrical hexagonal wrench flat. Service saddles shall be single strap style for tapping water main sizes four inches (4") through twelve inches (12") and double strap style for sixteen inches (16") and larger.

Curb stops or cocks shall include a padlock wing, and shall be connected by means of compression joints. Curb stops shall be suitable for potable water application, and shall not consist of any lead. Curb stops/cocks shall be B series as manufactured by Ford, or approved equal.

Corporation stops shall be connected by means of compression joints. Corporation stops shall not consist of lead. Corporation stops shall be F1000 series by Ford or approved equal.

209.2.2.4 Meter Boxes. Meter Boxes shall be made of high density plastic with multi-layer wall construction for maximum performance. Material density, as tested by ASTM D1505 method, shall be minimum 0.95 g/cc. Vertical loading shall be minimum fifteen thousand pounds (15,000 lbs). Sidewall loading shall be one hundred and fifty pounds (150 lbs.) per inch. Wall thickness shall be a nominal half inch (1/2 inch). Exterior surface shall be black, with UV protection for outdoor storage. Meters shall be within four inches from the top of the box. Meter box extensions three inches (3") and six inches (6") in height shall be provided as standard item from manufacturer.

209.2.2.5 Meter Box Lids. Lids shall be made of gray cast iron conforming to ASTM A48, Class 30B. Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage, cracks and other surface defects. Castings shall be ground smooth and well cleaned by shot blasting. As cast dimensions may vary within accepted foundry tolerances as outlined in the Iron Castings Handbook published by the American Foundry Society, Inc. Normally, casting dimensional tolerances shall be plus or minus one sixteenth of an inch (1/16") per foot. Castings shall be coated with a factory applied, water based, asphalt paint unless otherwise specified.

For meter boxes that house meters with Automatic Meter Reading (AMR) or Automatic Metering Infrastructure (AMI), meter box lids that are compatible with AMR/AMI shall be used. AMR/AMI compatible lids shall include a springhole and a plunger keyhole.

For conventional meters, both meter box and lid shall be manufactured according to the drawings supplied by the City. Weights shall be in accordance with weights shown on the drawings plus or minus five percent (5%). Both meter box and lid shall be manufactured in the USA. For AMR/AMI meters, the

Contractor shall use only products approved by the City or the Engineer.

**Concrete meter boxes shall not be permitted unless otherwise approved by the City Engineer or his authorized representative.*

209.2.2.6 Riser Pipes. Riser pipe shall be Six inch (6") PVC, Class 235, DR 18 in accordance with Section 209.1 herein.

209.3 FIRE HYDRANTS.

209.3.1 Materials.

209.3.1.1 Barrel. Hydrant barrels shall be cast of gray iron meeting ASTM A126, Class B, with hydrant shoe and gland being of the same material

209.3.1.2 Main Valve. Main valve seats on compression type hydrants, closing with the flow shall be of such design that incorrect positioning is impossible and that the threads will be adequately guided into position. Arrangements shall also be made to hold the main valve gasket in place during assembly. Valves shall be compression type shut-off in the direction of the flow. All operating parts (including valve seat, valve seat insert, cross-arm, upper valve plate, washer, etc.) shall be all bronze meeting either of the following: ASTM B61, B62, B98, B150.

209.4 WATERMAIN VALVES.

209.4.1 Materials.

209.4.1.1 Double Disc Gate Valves. All double disc gate valves 8-inch thru 48-inch shall conform to AWWA C500, except for changes or specified alternatives detailed in this specification, and shall be used for treated water transmission mains. Gate Valves larger than 48-inches shall be a special consideration. Double disc gate valves shall have a clear waterway equal to the full nominal diameter of the valve and shall have the manufacturer's initials, pressure rating, and year in which manufactured, cast in the body. Gate Valves shall be stem and nut operated. Direction of rotation of nut to open valve shall be left (counter clockwise). Hand wheels shall be furnished only when called for on the plans.

Unless otherwise specified by the Engineer, all gate valves shall be iron body, bronze mounted, double disc, parallel seat, non-rising stem internal wedge type with "O" ring seals. Double disc gate valves shall have mechanical joint ends (typically for buried installations), conforming to AWWA C111 or Flanged ends (typically for exposed installations), conforming to AWWA C110, Class 250 lb.

Bolts, nuts and washers for mechanical joints will be of high-strength low-alloy corrosion resistant steel conforming to ASTM A325 (Type 3). All mechanical joint glands will be cast iron. Epoxy coating, conforming to AWWA C550 shall be applied to the inside and outside ferrous metal surface. Double disc gate valves shall be as manufactured by Mueller, Clow, Kennedy, or approved equal.

209.4.1.2 Resilient Seated Wedge Gate Valves. Valves shall conform to the latest revision of AWWA Standard C509 or C515 covering resilient seated gate valves and approved by Underwriters Laboratory and Factory Mutual. This valve can be used with pipe sizes ranging from 8-inches thru 48-inches. Valves larger than 48-inches shall be a special consideration.

All resilient seated valves shall be non-rising stem. The stem shall be independent of the wedge and made of solid bronze. There shall be a smooth, unobstructed waterway in the flow area. The body and bonnet will be ASTM A126 Class B cast iron. The valves shall open to the left (counter clockwise). They shall have a two-inch square operating nut with the word open and an arrow cast in the metal to indicate the direction of opening.

The wedge shall be cast iron or ductile iron completely encapsulated with urethane rubber. The urethane

sealing rubber shall be permanently bonded to the wedge to meet ASTM tests for rubber metal bond ASTM D429.

Stems for the non-rising stem assembly shall be cast bronze with integral collars in full compliance with AWWA C509. The non-rising stem stuffing box shall be the O-ring seal type with two rings above the thrust collar. The two rings shall be replaceable with the valve fully open and subjected to full rated working pressure. The stem nut shall be bronze.

The body and bonnet shall be coated inside and outside with a fusion bonded epoxy that meets or exceeds all applicable requirements of AWWA C550. Each valve will have the makers name, pressure rating and year of manufacture, cast on the body. Prior to shipment from the factory, each valve will be tested by hydrostatic pressure as required for AWWA. The bolts and nuts will be Electro plated for long life corrosion protection. Anti-friction washers will be located under the stem collar for the aid of sealing and operation. Standard mechanical joint ends must comply with AWWA C550.

List of acceptable manufacturers include Mueller, Clow, Kennedy or equal.

209.4.1.3 Valve Boxes and Extensions. Cast Iron Valve boxes installed under this specification shall be those furnished by Tyler Pipe, Utilities Division, Tyler, Texas, 6850 Series, Two-Piece Screw Type. Valve boxes by other manufacturers shall be submitted for approval, these boxes shall be of equal cast dimensions, weights and lengths.

Contractor shall provide valve stem extensions with a minimum of two (2) alignment guides for installations where the valve nut is more than six (6') feet below the finished grade. Extension stems shall terminate one (1') feet below the top of the valve pad. Valve box lids shall be marked "WATER" and shall be non-locking.

209.4.1.4 Vertical Valves. Vertical Valves up to 16-inch in size shall come with an adjustable cast iron valve box. Valves 24-inches and larger shall require installation within a pre-cast manhole or valve vault as directed by the City or the Engineer.

209.4.1.5 Air Valves. Air valves for water service shall be combination air valves. The valve shall consist of a kinetic component and an automatic component. The kinetic component must discharge air at high velocity during filling of the system and admit air during its drainage. The valve should be designed to prevent premature closing and discharge air under differential pressure. The automatic component will release accumulated air from the system while operating under pressure.

The valve shall be designed to operate at a pressure range of 3 to 230 psi and shall be tested to 350 psi. The valve inlet shall be available in 2" NPT male threads or 2" to 8" flanged as specified. The valve shall be a D-040 series combination air valve manufactured by A.R.I. Flow Control Accessories or an approved equal.

209.4.1.6 Horizontal Gate Valves. Horizontal Gate Valves shall be used for pipeline sizes 24-inches in diameter and greater. They shall meet the same requirements as "Double Disc Gate Valves" of this specification, unless otherwise directed by the Engineer.

Horizontal valves shall be installed inside a water tight manhole or vault made from Class "A" Concrete, (See Specification 201.5 "Cement Mortar"). The manhole shall be as directed by the City or the Engineer. All horizontal valves shall have a by-pass valve as per the next paragraph, "By-Pass Valves" of this specification.

209.4.1.7 By-pass Valves. By-pass valves shall conform to the requirements of AWWA C500. By-pass valves shall be required for all valves twenty-four (24) inches and larger, and shall meet all the requirements of "Double Disc Gate Valves" in this specification.

By-pass valves shall be installed with a standard valve box and cover as per specifications, "Vertical Valves",

in this specifications.

When requested by the Engineer or if shown on the plans, by pass valves for vertical gate valves 16-inch thru 20-inch, shall be 3-inches in size. By-Pass valves for vertical gate valves 24-inches and larger shall be 4-inch.

209.4.1.8 Butterfly Valves. Butterfly Valves shall be mechanical joint, conforming to AWWA C504, Class 150B; with retainer glands. NOTE: Water lines containing butterfly valves may be cleaned and flushed in sections, at the Contractor's option. Any added cost for alternate pigging arrangements for water mains with butterfly valves should be included in the Contractors bid price for this item. The City will not accept claims for additional cost of this item. The Contractor should take this into consideration when pricing, planning and scheduling the work.

209.4.1.8.1 Valve Construction. All keys and pins used in securing valve disc to shafts shall be stainless steel (Type 316) or monel. Acceptable seating surfaces mating with rubber are Type 304 stainless steel or monel for all valves. Valve discs shall be constructed of cast iron, ASTM A48, Class 40; Ni-resist, ASTM A436, Type 1; or ductile iron, ASTM A536, Grade 65-45-12. The disc shall be designed to withstand full differential pressures across the closed valve disc without exceeding a stress equivalent to one fifth of the tensile strength of the material.

Shaft seals shall be of the Chevron or O-ring type. The maker's initials, pressure rating, model number, and year of manufacture shall be cast in a gray iron body conforming to ASTM A126.

Unless otherwise required by the Engineer, the direction of rotation of the wheel or wrench nut to open the valve, shall be to the left (counter clockwise). The valve body or operator shall have cast thereon the word "OPEN" and an arrow indicating the direction to open. By pass valves for butterfly valves shall only be installed when shown on the plans, or when requested by the Engineer. Butterfly valves shall be as manufactured by Clow, Mueller, Pratt or approved equal.

209.4.1.9 Tapping Sleeves. All sleeves in this specification 20" in diameter and larger and including all size on size water main taps shall meet the standards listed below.

209.4.1.9.1 Steel Sleeves. Steel sleeves shall be fusion bonded epoxy coated to an average of 12 mil thickness, in two sections, the halves to be bolted together along the pipe centerline. The body shall be carbon steel, ASTM A285 Grade C, Plate Steel, ASTM A36, or approved equal.

Flanges shall comply with AWWA C207 Class D, ANSI 150 pound drilling. The outlet flange shall be flat faced and recessed to mate with standard tapping valves per MSS SP60. Bolts and nuts shall be stainless steel Type 304.

Gaskets shall be compounded to resist water, oil, hydrocarbon fluids and withstand a maximum temperature of 212° Fahrenheit. The gasket shall be fitted around the recess of the tap opening in a way to preclude rolling or binding during installation.

209.4.1.9.2 Stainless Steel Sleeves. Stainless steel sleeves shall be full circle construction made completely from Type 304 stainless steel. All bolts and nuts shall be stainless steel Type 304. The flange shall be gasketed to accept a standard tapping valve. All gasket and rubber material for the flange gasket and circle seal portions shall be compounded to resist water, oil, hydrocarbon fluids, temperature up to 212° Fahrenheit and designed for water service.

209.4.1.10 Tapping Valves. Tapping valves shall conform to the requirements of AWWA C500. For 3" to 12" tapping valves, valve body shall be ductile iron, nut-operated, non rising stem gate valves suitable for buried service. The valve interior and exterior shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA Standard C550. List of acceptable manufacturers include American, Mueller, Clow, Kennedy. The exceptions to the AWWA C500 requirement are listed below:

- a. Tapping valves shall have oversize seat rings to permit entry of standard tapping machine cutters.
- b. In the open position, valve gates shall be clear of the ports so that cutter will pass through without making contact with the gates.
- c. Valves shall have an inlet flange conforming to ANSI B 16.1, Class 125, with a machined recess to mate the tapping sleeve outlet flange to assure correct alignment.
- d. Valves shall have a standard mechanical joint outlet end and shall fit any standard tapping machine.

209.5 GRAVITY SEWER MAINS.

209.5.1 General. In accordance with the requirements of these Specifications, City's Standard Specification 2000, City's Standard Plans, the contract documents, and other pertinent documents, the Contractor shall furnish materials and perform work necessary for or incidental to constructing a sanitary sewer piping system for the gravity sewers.

209.5.2 Materials. Materials shall be new and shall be from a single manufacturer. Submit 3 certified shop test reports (for each test) for the pipe and pipe fittings prior to installation, to demonstrate conformance with these technical provisions. In some instances, the Contractor may be required to install material supplied by the Owner or others. In such cases, the Contractor shall be responsible for installation according to specification requirements, and conducting field tests as required, but not for material certification tests. The different kinds and strengths of sewer pipe outlined in this section shall be used in the construction of sanitary sewer lines, unless otherwise approved, in writing, by the Engineer. The strength of pipe used shall be based upon standard engineering design procedures and manufacturer or trade association recommendations. The strength proposed shall be identified on the drawings and the contract specification. All pipes shall be circular unless otherwise approved. All pipe manufacturers must demonstrate a minimum of five (5) years manufacturing and installation experience specifically relating to the type of pipe being provided.

209.5.2.1 PVC Gravity Sewer Pipe. PVC pipe shall conform to cell classification 12454 per ASTM D1784 and shall meet chemical resistance classification of S47542 as described in ASTM D5260. PVC Pipe and fittings shall be extra strength minimum SDR-35 meeting the requirements of ASTM specification D3034 for 8"-15" diameter pipes and ASTM F679 for 18"- 36" diameter pipes, and shall have integral bell and spigot ends. Each integral bell joint shall be of the push-on type meeting the requirements of ASTM D3212 and shall consist of a formed bell, complete with a self-contained rubber ring gasket designed for close tolerances and thermal expansion and contraction. The rubber ring gasket shall conform to the requirements of ASTM F477. The insertion of the spigot end into the bell end shall form a compressed sealed joint providing maximum protection against infiltration in wet ground installations. PVC pipe for gravity sewers shall be as manufactured by JM Eagle, IPEX or approved equal.

Where non-metallic continuous restrained-joint PVC pipe with an integral bell and spigot system is specified, and when approved by the Engineer, Certa-Flo PVC pipe as manufactured by North American Pipe or approved equal shall be used. Certa-Flo PVC pipe shall be provided in Iron Pipe Size (IPS) outside diameters, and shall meet SDR-21 for 8 inch diameter pipe and SDR-26 for sizes over 8 inches. Certa-Flo PVC pipe shall be limited to 12 inches in diameter.

Manufacturer's representative requirements and Contractor's pipe crew installation experience shall conform to Section 2000.3.5 "Laying the Pipe". All PVC piping and fittings shall be from a single manufacturer and shall be stored on-site in accordance with the manufacturer's recommendations.

Sizes and dimensions for SDR-35 PVC Sewer Pipe shall be as follows:

NOMINAL SIZE	MINIMUM WALL THICKNESS	JOINT LENGTHS
8"	0.240	14/20 Ft.
10"	0.300	14/20 Ft.
12"	0.360	14/20 Ft.
15"	0.437	14/20 Ft.
18"	0.536	14/20 Ft.
21"	0.632	14/20 Ft.
24"	0.711	14/20 Ft.
27"	0.801	14/20 Ft.
36"	1.02	14/20 Ft.

209.5.2.1.1 PVC Fittings. All PVC pipe fittings and accessories shall conform to the requirements of ASTM D 3034 or ASTM F 679 and be furnished by the pipe supplier and shall have bell and/or spigot or mechanical joints compatible with the pipe. The stiffness of the fittings shall not be less than the stiffness of the adjoining pipe.

209.5.2.2 Closed Profile Wall PVC Pipe. Closed profile wall PVC (CPW-PVC) pipe and fittings shall be smooth inside and effectively smooth outside, and shall meet the requirements of ASTM F1803. CPW-PVC pipe shall have a minimum cell classification of 12364 per ASTM D1784, with a chemical resistance classification of S47542 as described in ASTM D5260. Pipe stiffness at 5% deflection (per ASTM D2412) shall equal or exceed 46 psi. CPW-PVC pipe shall be capable of passing an impact test of 220 ft-lbf when tested in accordance with ASTM D2444. An independent lab certification shall be provided with the submittal package to indicate that the pipe has been successfully tested to meet the aforementioned criteria.

Joints for CPW-PVC pipe shall be bell and spigot type with gaskets that meet the requirements of ASTM F477 and be molded into a circular form or extruded to the proper section, then spliced into circular form and shall be made of a properly cured high grade elastomeric compound. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. However, field installation may be allowed with written concurrence of the pipe manufacturer. Lubricants shall be suitable for use with PVC pipe, and elastomeric seals, and shall have not adverse effects on the gasket or on the pipe. Factory tapered spigot ends shall be made of PVC and shall be formed during the manufacturing process by heating the inner and/or outer wall and remolding. The use of putty, filler, rubber or plastic inserts or wedges to form either the inner or outer wall of the pipe will not be allowed on spigots or bells.

209.5.2.3 Ductile Iron Pipe. Ductile iron pipe shall be of the size and kind shown on the plans, or as specified herein. Ductile iron pipe and fittings shall conform to AWWA C150 and AWWA C151. Buried pipe shall be installed with an exterior bituminous coating in accordance with AWWA C151 and ASTM A746. The pipe shall be designed for the specified earth cover based on the laying condition Type 5. Ductile Iron pipe for sanitary sewer applications shall be interior lined with a two component amine cured Novalac epoxy of at least 87% solids and 40 mils thickness unless otherwise specified. Lining material shall be Protecto 401 by Induron Coatings, Birmingham, AL or an approved equal. The external pipe surface of buried pipe shall be coating with bituminous material in accordance with AWWA C104. Unrestrained joint pipe shall be either the rubber-ring type, push-on, or standard mechanical joint pipe as manufactured by the American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, Clow Corp./McWane, Griffin, or approved equal. All buried DI piping shall be polywrapped unless specified otherwise. Low density polyethylene wraps shall be 8 mils thick, and high density polyethylene wraps shall be 4 mils thick. Wraps shall be black in color and shall be stored suitably to prevent sunlight exposure. Polyethylene wraps shall conform to ASTM A674 standards. Exposed pipe shall be coated with a prime coat (3-5 mils dry) of Tnemec Series NI40 Pota Pox or approved equal, and a finish coat of Tnemec Series 431 Permashield or approved equal.

Ductile iron pipes shall be used for sewer works, unless otherwise specified and be of the pressure class listed below.

Pipe Sizes (inches)	Pressure Class (psi)
4-12	350
14-20	250
24	200
30-64	150

209.5.2.4 HDPE Pipe. High Density Polyethylene Pipe (HDPE) in accordance to these specifications shall be used in Horizontal Directional Drilling and pipe bursting installations. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM D3350, and ASTM F714 for pipe sizes 4-inch to 24-inch, with standard Ductile-Iron OD pipe sizing (DIPS) and a Dimension Ratio (DR) which meets the required Pressure rating and Total Allowable Occasional Surge Pressure. The following table shows the Pressure class for each DR.

Pipe Dimension Ratio	Pressure Class	Pressure Rating	Total Allowable Recurring Surge Pressure	Total Allowable Occasional Surge Pressure
DR 9	200 psi	200 psi	300 psi	400 psi
DR 11	160 psi	160 psi	240 psi	320 psi
DR 14.3	120 psi	120 psi	180 psi	240 psi
DR 17	100 psi	100 psi	150 psi	200 psi
DR 21	80 psi	80 psi	120 psi	160 psi

209.5.2.4.1 HDPE Pipe Material & Design. HDPE Pipe shall be extruded from a polyethylene compound and shall conform to the following requirements: The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 materials with a cell classification of PE 345464C, or better. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by pre-compounding in a concentration of not less than 2% percent. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.

HDPE Pipe joining shall be performed by thermal butt-fusion conforming to ASTM F2620 and by following the procedures recommended by the pipe manufacturer. Once the HDPE pipe has been fused, the interior of the pipe must be shaved to remove any beading, protrusions, etc., until the interior is smooth.

Joining to ductile iron pipe or fittings or PVC pipe shall be accomplished only using mechanical joint adapters (Harvey Adapter) fabricated from HDPE pipe conforming to ASTM 3350. Mechanical joint adapters must be complete with stainless steel Inside Diameter (ID) stiffeners and offer full axial restraint. The use of these adapters is limited to repairs of existing, in-use, pipelines that cannot be de-watered sufficiently to repair by fusion method. These adapters shall not be used for new installations.

The pipe shall be designed in accordance with the relationships of the ISO modified formula as stated in ASTM F714. All HDPE piping for sewer service shall include green stripes.

Accepted manufacturers include JM Eagle, National Pipe, Uponor Infra (KWH Pipe) or approved equal.

209.5.2.4.2 HDPE Fittings.

209.5.2.4.2.1 Butt Fusion Fittings. Fittings shall be made of HDPE material with a minimum material designation code of PE3608 and Butt Fusion Fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All fittings shall meet the requirements of AWWA C906. Markings for molded fittings shall comply with the requirements of ASTM D 3261. Fabricated fittings shall be marked in accordance with ASTM F 2206. Socket fittings shall meet ASTM D 2683.

209.5.2.4.2.2 Electrofusion Fittings. Fittings shall be made of HDPE material with a minimum material designation code of PE 3608. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting. Markings shall be according to ASTM F 1055.

209.6 SEWER FORCE MAINS.

209.6.1 General. This section specifies the materials to be furnished for assembling and installing sanitary sewer force mains. See City's Standard Specification Section 2100, City's Standard Plans, Contract Plans and Specifications, and other pertinent documents for more details.

209.6.2 Materials.

209.6.2.1 Ductile Iron Pipe. Ductile iron pipe shall conform to AWWA C151, minimum pressure class of 250 psi unless otherwise indicated. Ductile iron pipe and fittings shall be interior lined with a two component amine cured novalac epoxy of at least 87% solids, minimum 40 mils thick, and shall be Protecto 401 by Vulcan Painters, Birmingham, AL or approved equal. The external pipe surface shall require a bituminous coating in accordance with AWWA C104. Exposed pipe shall be coated with a prime coat (3-5 mils dry) of Tnemec Series NI40 Pota Pox or an approved equal, and a finish coat of Tnemec Series 431 Permashield or an approved equal.

Unrestrained joint pipe shall be either the rubber-ring type, push-on joint or standard mechanical joint pipe as manufactured by the American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, Clow Corp./McWane, Griffin, or approved equal. Unrestrained joints shall meet the requirements of AWWA C153. Rubber gaskets shall conform to AWWA C111 for mechanical or push-on type joints.

209.6.2.1.1 Fittings. Fittings shall be cast either of Gray Iron or Ductile Iron conforming to ANSI Specification A21.10 (AWWA Standard C110), ANSI/AWWA C153/A21.53. Joints for cast iron fittings shall be mechanical joint conforming to AWWA Standard C111, unless otherwise approved.

209.6.2.2 PVC Pipe. PVC force main pipe 4 to 12 inches in diameter shall conform to AWWA C900 (green color PVC pipe for sewer), with a DR of 18. PVC forcemains, ranging in diameter from 14 to 48 inches shall conform to AWWA C905 water pipe standards. PVC force mains ranging in diameter from 14 to 30 inches shall have a minimum DR of 18 and a pressure rating of 235 psi. PVC Pipe larger than 30-inches shall have a minimum DR of 25 and pressure rating of 165 psi.

Gasket, integral bell and spigot or double bell couplings with plain end spigot type joints shall be used on PVC pipe 4 inches or greater in diameter. Gasket joints shall conform to ASTM D3139, gaskets shall conform to ASTM F477. All PVC piping and fittings shall be from a single manufacturer, PVC pipe shall be as manufactured by JM Eagle, IPEX, or approved equal.

Where non-metallic continuous restrained-joint PVC pipe is specified, and when approved by the Engineer, Certa-Lok PVC pipe as manufactured by North American Pipe or approved equal shall be used. Certa-Lok PVC pipe shall meet DR-14 rating. Certa-Lok PVC pipe or approved equal shall be limited to 12 inches in diameter.

209.6.2.2.1 Fittings. PVC fittings shall have a cell classification of 12454 per ASTM D1784, with a chemical resistance of S47542 per ASTM D5260.

209.6.2.3 HDPE Pipe. High Density Polyethylene Pipe in accordance to these specifications shall be used in trenchless installations. HDPE Pressure Pipe shall meet or exceed the requirements of AWWA C906 with standard Ductile Iron OD Pipe Sizing (DIPS), a working pressure rating of 160 psi and a Dimension Ratio (DR) of 11 for pipe sizes 4" through 24".

HDPE pipe shall be made from polyethylene resins that meet or exceed the requirements of ASTM Material Designation Code PE 3408. The polyethylene resins shall also meet or exceed the requirements of ASTM D3350 cell classification 345464C.

209.6.2.3.1 Joints. Joints for HDPE pipe shall be heat fusion joints conforming to ASTM D2657 requirements. Once the HDPE pipe has been fused, the interior of the pipe must be shaved to remove any beading, protrusions, etc., until the interior is smooth. Joining to ductile iron pipe or fittings or PVC pipe shall be accomplished using mechanical joint adapters (Harvey Adapters). Mechanical joint adapters must be complete with stainless steel ID stiffeners.

209.6.2.3.2 Fittings. All fittings used in connection with HDPE pipe shall be ductile iron conforming to AWWA C153. Joints for cast iron fittings shall be mechanical joint conforming to AWWA C111, unless otherwise approved.

209.7 MANHOLES.

209.7.1 Materials.

209.7.1.1 Precast Concrete Manhole. Precast concrete manhole riser sections shall conform to the requirements of ASTM Designation C478. The monolithic concrete pour shall be minimum 4000 psi strength at 28 days. The precast sections shall not be delivered to the construction site before all relevant submittals have been approved and the concrete has cured for a minimum ten (10) days. A copy of the manufacturer's production schedule must be delivered with the manholes for onsite City inspection and approval.

Manhole pipe cutouts in the base section shall be appropriately sized to ensure a tight fit for the new pipe being connected and shall conform to the water stop requirements detailed herein. Each cutout shall be marked to identify each new pipeline connecting to the manhole. The cone or top section shall be precast concentric, unless otherwise specified on the plans. The precast riser section (tongue & groove) joint shall contain a circumferential one-piece artificial rubber gasket, similar or equal to a flexible lubricated O-ring seal or sliding flap-fold type pre-lubricated rubber seal, conforming to the requirements of ASTM C443 and C361; (Ram-Nek gasket material is prohibited). Gaskets for joints between manhole sections shall conform to ASTM C443. Connectors for making joints between manhole and pipes entering manhole shall conform to, ASTM C923 or, ASTM C990.

All precast manholes shall be constructed with a one-foot concrete grade section directly below the cone or top section in order to lower the manhole for any future grade adjustments.

209.7.1.2 Cast-in-place Manhole. Cast-in-place manholes shall be made of 4000 psi concrete and #4 rebars (see Standard Plan 2200-2). Wall thickness shall be a minimum of 8" thick for a manhole 0' to 12' deep. For each additional 6 foot of depth, an additional 2" of wall thickness shall be added. For a manhole 0' to 12' in depth, the base shall be at least 10" thick. For a manhole over 12' deep, the base shall be at least 12" thick.

209.7.1.3 Manhole Coatings. Interior surface of manholes shall be factory coated with a minimum 14 mil thickness of coal tar epoxy meeting requirements of U.S. Corps of Engineers Specifications C200,

such as Bitumastic 300M manufactured by Carboline Company, Koppers Company or approved equal.

Exterior surface of precast manholes shall be factory coated with a minimum 10 mil thickness of a bituminous sealant meeting E.P.A. regulations. Breaks and pinholes in coating shall be avoided.

209.7.1.4 Special Interior Coating. Manholes requiring locked sealed covers and/or force mains drop structures shall require an interior surface application of a 100% solids flexibilized epoxy protective coating applied at minimum thickness of 80-125 mils as directed by the City or Engineer. Monolithic manhole liners shall be installed when specified in the technical plans, Engineer's specifications or when directed by the Engineer. See Standard Specification Section 2220 for more details.

209.7.1.4.1 Properties of Special Coatings. The coating shall be a high-build, anti-corrosive, anti-abrasive, flexible, and non-solvent epoxy. The coating material shall be resistant to sulfuric acid, nitric acid, chromic acid, phosphoric acid, stearic acid, ferric chloride, magnesium chloride, vegetable fats, animal fats, petroleum oils, petroleum greases and soaps. It shall be impervious to sewer gases and liquids and shall be non-conductive to bacterial or fungus growth.

209.7.1.4.2 Application Procedures. The specialized interior coating for precast manholes shall be factory coated and cured dry before shipment. Interior surface coat shall be smooth and free from air pockets causing concrete exposure. If concrete exposure is minimal and acceptable to the City, the contractor shall field apply the specialized coating to the exposed areas as per manufacturer's instructions. The Contractor shall furnish copies of the manufacturer's recommended field coating application procedure as part of his construction submittals. Monolithic manholes shall be applied per the manufacturer's recommendations.

209.7.1.5 Drop Manhole Structures. Materials used in the construction of manholes with drop structures shall be the same as precast or cast-in-place manholes described herein. A drop structure manhole shall be installed when the elevation of the inflow pipe is two (2) feet or greater above the manhole flow line elevation. Drop structure manholes shall be constructed as outlined herein and as identified in STANDARD PLAN No. 2200-7. The exterior drop pipe structure shall be encased in minimum six (6) inches thick concrete. The concrete encasement pour must affix to the exterior wall and base of the new manhole to ensure structural stability. The sewer pipe rate of flow will determine the pre-designed drop of using a 45 degree wye or 90 degree tee connection to the manhole. The interior surface of a drop structure manhole requires a specialized epoxy coating as identified in Section 209.7.1.4 "Special Interior Coating". (Circular sonitubes will not be accepted as pre-forming material for drop structure concrete encasement).

209.7.1.6 Standard Cast Iron Manhole Frames and Covers. The casting of manhole frames and covers shall conform to the Standard Specification for Drainage, Sewer, Utility, and Related Castings, AASHTO Designation: M-306. They shall be Model V-1243 as manufactured by East Jordan Iron Works or approved equal. Total weight for each combined frame and cover locking unit shall be a minimum of 310 lbs.

The machined bearing surfaces between the frame and cover shall permit a firm tight fit. Any cover that displays an unlevel rocking motion is unacceptable and shall be rejected and replaced. The cover shall include two (2) type I pick slots and two (2) three quarters of an inch (3/4") pick holes. The cover face shall display the standard perimeter embossed CITY OF SHREVEPORT- SEWER, centered with the (Louisiana State Pelican) logo, as identified herein (STANDARD PLAN No. 2200-6). Frames and covers shall meet all of the above established minimum specification standards and shall require approval from the City or Engineer.

When directed by the Engineer, elastomeric manhole frames and covers shall be used for manholes with highly corrosive conditions. Elastomeric frames and covers shall be as manufactured by Hamilton-Kent or approved equal. See Standard Specification Section 2210.12 for more details regarding elastomeric frames and covers.

209.7.1.7 Locking And Sealing Covers. Castings shall meet the material requirements detailed above, except ductile iron may be used in lieu of cast iron. They shall be model V-2480-I as manufactured by East Jordan Iron Works, or approved equal. A neoprene gasket shall be provided for sealing. Total weight for each combined frame and cover locking unit shall be a minimum of 310 pounds. Four (4) anchor bolts shall be provided in the frame for anchoring to the top. Watertight covers of the same part number shall be interchangeable.

209.7.1.8 Manhole Water Stops. A factory installed flexible rubber compression connector (pipe to manhole) seal shall be cast integrally with the precast concrete manhole wall, similar or equal to A-Lok X-Cel, for sanitary sewers, meeting or exceeding ASTM C923. The use of an alternative flexible neoprene self-expanding connector boot with stainless steel band clamps similar or equal to "Kor-N-Seal" and "Press-N-Seal", meeting ASTM C443 and C923 is acceptable. Contractor must obtain approval from the City or Engineer for the type (pipe to precast manhole) of connector application.

Manhole riser section (tongue to groove) joints shall contain flexible O-ring seals or sliding flap-fold type pre-lubricated rubber seal, conforming to the requirements of ASTM C443 and C361; (Ram-Nek gasket material is unacceptable and prohibited). An internal rubber (chimney) seal shall be installed in manholes. The seal shall be manufactured in accordance with ASTM C923. The stainless steel bands for manhole cover risers shall be 16 gauge conforming to ASTM A240, type 304 stainless steel with all nuts, bolts, screws, etc., conforming to ASTM F593 and F594.

Water stop materials utilized for precast manholes shall be capable of passing the specified "Air Vacuum Testing" requirements established in Section 2200.3.11 herein.

An existing sewer manhole receiving new sewer pipe re-connections shall require a flexible circumferential rubber gasket installed around the pipe at the point of penetrating the manhole wall. The rubber gasket(s) seal shall be the full width thickness of the manhole wall. A single or multiple gasket application shall fit water tight around the pipe. Once centered in place, non-shrink grout shall be applied to fill the periphery space around the pipe both inside and outside the manhole. Other introduced water stop materials shall require approval from the City or Engineer.

209.8 MANHOLE INFLOW PREVENTERS.

209.8.1 Materials. Manhole inserts shall be manufactured of high quality polyethylene or stainless steel and insert components shall be manufactured from corrosion proof materials suitable for exposure to road salts, oils, fuel, hydrogen sulfide, dilute sulfuric acid and other gases common to sewerage systems. The material shall be freeze-thaw resistant and withstand a temperature range of minus fifty degrees (50°) Fahrenheit to two hundred and forty five degrees (245°) Fahrenheit.

The inserts shall be properly sized for the specific manhole frame and cover in which they will be fitted and shall have a stainless steel or nylon web handle capable of withstanding a pull of 500 pounds of force. The handle shall not interfere with the installation of the manhole lid and it is to be attached to the body with stainless steel rivets and washers.

The insert shall have an approved system of relieving gas and vacuum pressure of not more than one psi above atmospheric pressure and shall be complete with a gasket. The insert shall have a corrosion-resistant strap within the bowl for ease of installation and removal.

A security locking device shall be provided for all manhole inserts. Each insert shall have a factory installed 3/16 inch stainless steel retaining cable that is at least five feet (5') long. It shall pass through a water tight grommet in the bottom of the dish and have a high grade stainless steel adjustable locking device located between the bottom of the preventer and the left loop at the end of the cord.

209.8.1.1 Plastic Inflow Preventers. The body of the plastic inflow preventer shall be manufactured of High Density Polyethylene that meets the requirements of ASTM D1248 Class A, Category 5. The body shall have three or more ribs in the bottom for structural strength and lid deflection. The manufacturer shall furnish a "Load Test Verification" showing a "Load Test Failure" in excess of 800 pounds.

A gasket to be installed by the manufacturer shall be provided. The gasket shall be envelope ribbed on one side to provide a positive seal. The gasket, by design, shall not separate from the insert during installation and removal. It shall be permanently attached to the insert by means of chemical bonding.

Refer to STANDARD PLAN No. 2200-6 for pertinent details.

209.8.1.2 Stainless Steel Inflow Preventers. The stainless steel inflow preventer body shall be manufactured of 304 Stainless Steel with a thickness of at least 18 gage and must be able to support a minimum load of 1200 pounds. The insert shall have a straight side design to allow a loose fit into the manhole ring for easy removal. The Contractor must obtain insert manufacturer "Load Test Verification" documentation showing a "Load Test Failure" in excess of 1200 pounds.

A gasket made of close cell neoprene shall be provided and installed by the manufacturer. It must be compatible with the insert material to form a long-lasting bond in wet or dry conditions.

SECTION 210

PAINT AND PROTECTIVE COATINGS

210.1 GENERAL. Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the use for which it is specified. The pigment shall be finely ground and properly dispersed in the vehicle according to the requirements of the paint, and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened, air-tight containers, appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, State specification number, and lot or batch number.

No paint shall be used until at least seven (7) days have elapsed from the date of manufacture.

210.2 TESTING. When required by the Engineer, paint and paint materials shall be sampled and tested prior to use. All tests will be conducted in accordance with the methods specified in ASTM or methods set forth in Federal Standard 141. In the absence of any such methods, other suitable methods may be designed and utilized by the Engineer.

Lots or batches of paint of proprietary brand, which have been previously sampled and tested by the Agency and approved as conforming with these specifications, may be used without further testing, if permitted by the Engineer. For the purpose of these specifications, proprietary brands of paint and paint material are construed to mean those conforming to the requirements of these specifications which are produced for distribution through regular wholesale and retail outlets.

210.3 PAINT COATS. Paint coats shall consist of primer, pretreatment when specified, and finish coats in that order in accordance with Subsection 210.5.

210.4 PAINT MATERIALS. Paint materials shall conform in all respects to the requirements of the reference specifications indicated for such material in the following table of paint systems.

210.5 PAINT SYSTEMS. Unless otherwise specified, the paint systems to be used will correspond with the following. For each paint description, refer to Federal Specification Standard.

Zinc coated Steel

- 1st coat - Zinc dust - zinc oxide primer (TT-P-641)
- 2nd coat - High gloss alkyd enamel (TT-E-489 Class A)
- 3rd coat - High gloss alkyd enamel (TT-E 489 Class A)

Ferrous Metal

- 1st coat - Red oxide zinc chromate primer (TT-P-636)
- 2nd coat - Semi-gloss alkyd enamel (TT-E-529 Class A)
- 3rd coat - Semi-gloss alkyd enamel (TT-E-529 Class A)
- First coat not required on items delivered shop primed.

Painted Wood (General)

1st coat - Primer undercoat (TT-P-25)

2nd coat - Acrylic emulsion (TT-P-19)

3rd coat - Acrylic emulsion (TT-P-19)

Protective Coating (surface as indicated)

Asphalt Paint - ASTM D41 or 43

210.6 PAINT FOR TRAFFIC STRIPING

210.6.1 General. Paint for traffic striping and marking shall correspond with the requirements as shown in the following table:

PAINT FOR TRAFFIC STRIPING AND MARKING

TYPE OF PAINT	REFLECTIVE MATERIAL	SYSTEM
Thermoplastic	DOTD Spec. 1015.10(d) Added to the paint during manufacture	DOTD Spec 1015.10

210.6.2 Thermoplastic Paint. DOTD Specification 1015.10. Thermoplastic traffic line paint shall be a reflectorized thermoplastic pavement striping material applied to the road surface in a molten state by mechanical means. It shall have surface application of glass beads which, upon cooling to normal pavement temperature, will produce an adherent reflectorized stripe of the specified thickness and width, and will be resistant to deformation by traffic.

The material shall contain at least 15% by weight of glass beads in the white and yellow paints and at least 12% titanium dioxide in the white paint. The material, when applied at a temperature range of 400°F - 425°F (204°C -218°C), and a thickness of 125 mils (1/8 inch) (3.175 mm) to 188 mils (3/16 inch) (4.762 mm), shall set to bear traffic in not more than 2 minutes when the air temperature is 50°F (10°C) and not more than 15 minutes when the air temperature is 90°F (32°C).

210.6.3 Rapid Dry White, Yellow, or Black Traffic Line Paint. Rapid dry white, yellow, or black traffic paint shall dry to a condition so that there will be no traffic pick-up in 30 seconds, and which shall be completely dry in not more than 3 minutes when pre-heated to 110°F - 180°F (43°C - 82°C) in proper equipment before application. The "no traffic pick-up" time shall be determined by ASTM D 711.

210.6.4 Ready-Mixed Traffic Stripe Paints. Where ready-mixed paints are specified, they shall be suitable for use on either asphalt concrete or portland cement concrete.

210.6.5 Reflective Material. Reflective material shall consist of glass beads added to the surface of the final coat of paint prior to setting, so that the beads will have proper adhesion. Special care shall be taken with rapid dry paint and thermoplastic materials.

Glass beads shall conform to DOTD Specification 1015.10 (d) and shall be mechanically applied at a rate of 6 to 8 pounds of beads per gallon (0.72 to 0.96 kg per liter) of paint. Glass beads shall be applied to pavement markings, curbs and crosswalks by use of a dispensing device developed for this purpose or other methods approved by the Engineer.

The Engineer may authorize the use of paint containing pre-mixed glass beads. The type, gradation, quantity and quality of the pre-mixed glass beads shall be approved prior to the manufacture of the paint. In addition to the specified pre-mixed beads, 2 to 3 pounds of beads per gallon (0.24 to 0.36 kg per liter) of paint shall be mechanically applied when the paint is applied.

If thermoplastic paint is required, glass beads may be added directly to the combined pigment, filler and resin in accordance with Subsection 210.6.2.

210.7 PAVEMENT MARKINGS.

210.7.1 Tape. Marking material shall be a pressure-sensitive pavement striping tape made especially for highway use. Tape shall have a precoated pressure-sensitive adhesive which shall not require a liner for protection from contamination, pre-adhesion or blocking within the roll, or require activation procedures and shall adhere to asphaltic or concrete surfaces when applied according to manufacturer's recommendations at surface temperatures to 35°F (1°C) min. The material shall be thin, flexible and formable, and following application shall remain conformed to the texture of pavement surfaces. Average thickness of material shall be 9 mils min. Minimum reflectivity for material shall be 0.18 candlepower per foot candle per square foot when tested at a divergence angle of .2 and an incidence angle of 86°. Striping tape shall be removable by following manufacturer's recommendations so long as the material is substantially intact. Removal shall not require sandblasting, or grinding methods and shall not result in objectionable staining of pavement surface.

210.7.2 Raised Pavement Markers. Raised markers shall be Class I nonreflectORIZED, Class IV- reflectORIZED or ceramic with reflective delineators as specified or indicated on Drawings. Markers shall be as approved by the Traffic Engineering Department of the City. Colors shall be as specified.

210.7.2.1 Description.

- (a) Class I markers shall consist of an acrylonitrile - butadiene - styrene polymer or approved equal Class I-A markers shall be 4" x 12" (101.6 cm x 304.8 cm). Class I-B markers shall be 4" x 6" (101.6 cm x 152.4 cm). Class I markers shall be used primarily for traffic rumble strips.
- (b) Class IV markers shall consist of acrylonitrile - butadiene - styrene or methyl methacrylate body or shell filled with a mixture of an inert thermosetting compound and filler material, or approved equal. The reflecting system shall consist of prismatic reflector lens or spherical reflecting system with biconvex glass elements, or approved equal. Class IV markers shall be used primarily for delineation of traffic lanes.
- (c) Ceramic markers shall consist of a ceramic dome base with a cylindrical lens reflector inserted in and adhered to the base. Bottom surface shall be unglazed. Ceramic material shall be vitrified with colored semi-opaque (fired at 2500°F). The reflective delineator shall be a single glass cylinder 1-3/4" x 3/8". Size shall be 4 - 3/4" (120.65 mm) x 3/4" (19.05 mm) max.

210.7.2.2 Physical Requirements. All markers shall meet or exceed Resistance tests for heat, impact and load

when tested in accordance with Louisiana DOTD TR 621.

210.7.2.3 Optical Requirements. Class IV markers shall conform to the following requirements when tested in accordance with Louisiana DOTD TR 604.

Color	<u>Footlamberts</u>			
	Angle of Incidence			
	0°		20°	
	Avg.	Min.	Avg.	Min.
Crystal	125	100	60	50
Amber	80	65	35	25
Red	25	15	15	10

For the ceramic reflective pavement markers, the specific intensity of the reflective surface at 1/5° (.2) divergence angle shall not be less than the following when the incident light is parallel to the base of the marker.

<u>SPECIFIC INTENSITY</u>			
<u>Hor. Eng. Angle</u>	<u>White</u>	<u>Amber</u>	<u>Red</u>
0°	3.0	2.0	.4
20°	1.5	1.0	.2

The reflectivity of the markers shall be not less than 80% of the above minimum values after being subjected to the heat test required in Subarticle 210.7.2.2.

210.7.2.4 Adhesive. The adhesive shall be a two component system consisting of the epoxy resin and hardener. Equal parts, by volume, of the resin and hardener components must be mixed together to obtain the finished adhesive. The adhesive shall be specified by the supplier as being either standard set or rapid set and shall conform to AASHTO Specification No. M237.

210.8 GALVANIZING.

210.8.1 General. Zinc used for galvanizing shall be grade Prime Western conforming to ASTM B 6. Except as otherwise specified, materials shall be galvanized by the hot-dip or electro-depositing process.

210.8.2 Requirements of Coating. The minimum weight of coating and other requirements shall be as shown in the following table. The weight shown is ounces per square foot of surface area. The weight of coating shall be determined in accordance with ASTM A 90, modified to determine the coating of each surface separately. All surfaces, when tested separately, shall meet the minimum requirement.

Material	ASTM Test Method No.	Weight of Coating	
		Oz./sq. ft.	(Kg/m ²)
Steel products including structural shapes, tie rods, handrails, manhole steps, fence posts, braces, and miscellaneous items	A 123	2.00	(.61)
Hardware including castings, rolled, pressed and forged articles	A 153	2.00	(.61)
Bolts, screws, nuts and washers	A 153	1.25	(.38)
Chain link fence fabric (Galv. after fabrication)	A 392	1.20	(.37)
CMP culverts and underdrains	A 444	1.00	(.31)
Steel pipe (including fence posts)	A 120	1.80	(.55)
Iron or steel wire fencing	A 116	0.80	(.24)
Steel or iron sheets	A 525	0.63	(.19)
Barbed wire	A 121	0.50	(.15)

210.8.3 Workmanship. The zinc coating shall adhere tenaciously to the surface of the base metal. The finished product shall be free from blisters and excess zinc, and the coating shall be even, smooth, and uniform throughout. Machine work, die work, cutting, punching, bending, welding, drilling, thread cutting, straightening and other fabricating shall be done as far as is practicable before the galvanizing. All members, nuts, bolts, washers, etc., shall be galvanized before a structural unit is assembled. All uncoated spots or damaged coatings shall be cause for rejection.

Products that are warped or distorted to the extent of impairment for the use intended shall be rejected.

210.8.4 Repair of Damaged Zinc Coating. Zinc coating which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such extent as to expose the base metal, shall be repaired and recoated by one of the following methods:

210.8.4.1 Hot-Dip Process. The damaged areas shall be thoroughly stripped and cleaned and a coating of zinc shall then be applied by the hot-dip process.

210.8.4.2 Metalizing Process. The damaged area shall be thoroughly cleaned by blasting with sharp sand or steel grit. The blasted area shall lap the undamaged zinc coating at least ½ inch (12.7 mm).

Zinc wire containing not less than 99.98% zinc shall be used in the metalizing operation. A zinc coating shall be applied to the damaged area with a metalizing gun to a thickness of not less than 0.005 inch on the damaged area, and shall taper to zero thickness at the edge of the blasted undamaged section.

210.8.4.3 Zinc Oxide-Zinc Dust Paint. The damaged area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145.

The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.

210.8.4.4 Proprietary Materials. Small areas may be repaired by coating them with such proprietary materials as galvicon or galvalloy or an approved equal.

SECTION 211

GEOTEXTILE FABRIC AND GEOCOMPOSITE SYSTEMS

211.1 GEOTEXTILE FABRIC.

(a) General Requirements: The geotextile fabric shall be composed of at least 85 percent by weight (mass) of polyolefins, polyesters, or polyamides. The geotextile fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which adversely alter its physical properties. When required, the geotextile fabric shall contain stabilizers and/or inhibitors added to the base material to make filaments resistant to deterioration due to ultraviolet and heat exposure. Edges of geotextile fabric shall be finished to prevent the outer yarn from pulling away from the fabric. Fibers of other composition may be woven into the geotextile fabric for reinforcing purposes. Durability of these fibers shall be equivalent to that of the geotextile fabric.

Geotextile fabric rolls shall be furnished with an opaque, waterproof wrapping for protection against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged with the manufacturer's name, date of manufacture, batch number, name of product. Unless otherwise specified on the plans or in the project specifications, the geotextile fabric shall be an approved product.

(b) Detailed Requirements: The geotextile fabric shall comply with the requirements in Table 211-I and shall be utilized as follows unless otherwise specified:

<u>Use</u>	<u>Classes</u>
(1) Drainage:	
Underdrains	A, B, C or D
Pipe and Precast Manhole Joints	A, B, C or D
Weep Holes	A, B, C or D
Bedding Fabric	B, C, or D
Approach Slabs	B, C, or D
Fabric for Geocomposite Drainage Systems ¹	B, C, or D
(2) Stabilization:	
Bulkheads	C or D
Flexible Revetments	C or D
Rip Rap	D
Railroad Crossings	D
Soil Stabilization	C, D, or S
(3) Paving Fabric: ²	B or C (modified)
(4) Silt Fencing:	
Wire Supported	F
Self Supported	G

¹ Refer to Subsection 211.2 for additional requirements.

² Refer to Subsection 211.3 for additional requirements.

**Table 211-I
Geotextile Fabrics**

Property	Test Method	Requirements Classes						
		A	B	C	D	S	F	G
AOS, Metric Sieve, μm , Max.	ASTM D 4751	300	300	300	212	600	850	850
Grab Tensile, N, Min.	ASTM D 4632	330	400	580	800	800	400	400
% Elongation @ Failure, Min.	ASTM D 4632	---	---	50	50	---	---	---
% Elongation @ 200 N, Max.	ASTM D 4632	---	---	---	---	---	---	50
Burst Strength, N, Min.	ASTM D 3787	440	620	930	1290	1390	---	---
Puncture, N, Min.	ASTM D 4833	110	130	180	330	330	---	---
Trapezoid Tear Strength, N, Min.	ASTM D 4533	110	130	180	220	220	---	---
Permittivity, Sec.-l, Min	ASTM D 4491	1.0	1.0	1.0	1.0	0.2	0.01	0.01
Grab Tensile Strength Retained after weathering 150 h, UVA lamps, %, Min	ASTM D 4632 ASTM G 53	70	70	70	70	70	---	---
Grab Tensile Strength Retained after weathering 500 h, UVA lamps, %, Min	ASTM D 4632 ASTM G 53	---	---	---	---	---	70	70

211.2 GEOCOMPOSITE DRAINAGE SYSTEMS. The geocomposite fabric drain shall consist of a non-woven geotextile fabric and a core as specified below with the geotextile completely enveloping the core. Fittings shall be as recommended by the manufacturer. The geotextile fabric shall be sufficiently secured to the core to prevent separation of the geotextile fabric and intrusion of the backfill material during installation. The geocomposite drainage system shall be an approved product.

(a) Geotextile Fabric: The fabric shall meet the requirements for Class B, C, or D geotextile fabric of Subsection

211.1 with the following modifications:

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Elongation, %, Min.	ASTM D 4632	20
Shear Seam Strength (Fabric to Fabric), N/mm width, Min.	ASTM D 4437	2600

(b) Cores for Wall Drains (Single Sided): The core shall be a flexible, solid-backed, rectangular design made of a polyolefin material not sensitive to moisture. The geocomposite design shall allow drainage of water from one side only. The core shall consist of supports having a minimum height of 5/16 inch (8 mm) upon which the fabric shall be securely fastened. The cross section open area of the core which will allow the passage of water shall be a minimum of 40 percent. The core shall meet the following requirements:

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Compressive Strength, kPa @ 20% Max. deflection, Min.	ASTM D 1621	308

211.3 PAVING FABRIC. In addition to the specifications for Class B or C geotextile fabric of Subsection 211.1, the paving fabric shall also comply with the following requirements:

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Asphalt Retention, L/sq m	AASHTO M 288	0.9
Change in Area at 135°C, %, Max.	AASHTO M 288	15.0

SECTION 212

EROSION CONTROL MATTING AND HARDWARE

212.1 EROSION CONTROL MATTING AND HARDWARE.

(a) General: Erosion control systems shall consist of approved hydraulically applied fiber mulch systems, or rolled erosion control products (mats) including hardware and installation plan.

(b) Requirements: Erosion control systems shall comply with the performance requirements in Table 210-I when evaluated in accordance with the City's qualification procedure for erosion control systems.

Table 212-I
Erosion Control Systems

Slope Protection			
Type ¹	Test Site Conditions for Evaluations	Maximum Sediment Loss, lb/yd ² (kg/m ²)	Minimum Vegetation Density, %
A	3:1 Slope	0.06 (0.034)	80
B	2:1 Slope	0.06 (0.034)	80
Flexible Channel Liners			
Type ¹	Test Site Conditions for Evaluation	Maximum Sediment, inches (mm)	Minimum Vegetation Density, %
C	Shear Stress Range 0 to 2 psf (0 to 96 Pa)	0.45 (11.5)	70
D	Shear Stress Range 0 to 4 psf (0 to 192 Pa)	0.40 (10.0)	70
E	Shear Stress Range 0 to 6 psf (0 to 287 Pa)	0.40 (10.0)	70
F	Shear Stress Range 0 to 8 psf (0 to 383 Pa)	0.30 (8.0)	70

¹ Types are listed in increased order of protection.

The manufacturer's installation plan shall include a description of all hardware and shall comply with the installation procedure used during the evaluation of source approval. A copy of the approved installation plan shall accompany each shipment.

SECTION 213

TRAFFIC SIGNAL MATERIALS

213.01 TRAFFIC SIGNAL HEADS.

213.01.1 General Requirements: Traffic signal sections, beacon sections and pedestrian signal sections shall be of the adjustable type. Materials and construction of each section shall be the same. Signals shall be constructed for either 8 or 12-inch (200 mm or 300 mm) lens in accordance with the plans. Signal sections shall have three to five sections per face and beacon sections have only one section per face. Signal sections and associated brackets shall be finished inside and out with two coats of high grade green enamel (Outdoor Advertising Association No. 144) with each coat independently baked. Visors shall be coated green on the outside and black on the inside. Edges shall be deburred and smooth with no sharp edges.

213.01.2 Housing, Housing Doors, and Visors: Housing and doors shall be constructed of cast aluminum conforming to ASTM B 85 or B 108 with a minimum tensile strength of 17,000 psi (117 MPa). Hardware for the signals, such as hinges, locking devices, screws, bolts, etc., shall be stainless steel.

- (1) **Housing:** Housing shall be sectional and each face shall consist of as many sections as there are optical units, with a suitable top and bottom. Sections shall be rigidly and securely fastened together in a manner that provides mechanical integrity and a weatherproof optical unit. Each face shall be provided with round openings (slip-fit for 2-inch (50 mm) opening) in the top and bottom so that it may be rotated 360 degrees about its axis as a complete unit between waterproof supporting brackets or trunnions and be capable of being directed and locked at 5 degrees intervals. Serrations, detents, bolts, or similar locking devices are required. Friction will not be an acceptable lock. These locks shall be such that any face will resist a torque of 20 ft-lb (27 N-m) when assembled in accordance with the manufacturer's recommendations.

The portion of the housing adjacent to the bracket shall be reinforced to have sufficient strength against breakage from shock. Seals, gaskets, labyrinths, or a suitable combination shall be provided at bracket attachment points and at section joints to ensure water shedding. Supporting brackets or trunnions shall be used at the top and bottom of section assemblies to rigidly support all faces. The bracket at the supported end of the signal section shall be 1 1/2 inch (38 mm) conduit or a conduit with an equivalent inside clearance for wiring. The bracket at the opposite end of the section may be either the same as the top or solid. A set screw engaging a drilled hole shall be provided at each joint on the bracket where conduit type joints are used or an equivalent locking device shall be provided.

A 6-position terminal block for connection of wires from the socket and incoming wires from signal circuits shall be provided in the center section of the signal housing and shall include provisions for grounding.

- (2) **Housing Doors:** Housing doors shall contain locking devices which can be operated without tools. Door hinge pins shall be designed so that the door will not become disconnected from housing when open, regardless of signal position. Doors shall be field removable. Weather resisting, mildew-proof neoprene or silicone rubber sponge gasketing between the body of the housing and the doors shall be provided that will exclude dust and moisture.
- (3) **Visors:** Each signal section shall have a visor in accordance with the plans which tilts downward approximately 8 degrees from the horizontal. Visors shall be constructed of aluminum alloy sheet not less

than 0.05 inch (1.3 mm) (No. 18 Gage) thick, or plastic (when specified). Visors shall be the standard Type A as shown on the plans. Type B tunnel visors shall be used where louvers are shown on the plans. Louvers shall be five vane and painted flat black. Visors shall be designed to fit tightly to the door and shall not permit any filtration of light between door and visor.

Visors for pedestrian signals shall be Type A and shall encompass the tops and sides of the signal face and be a shape and size to adequately shield the face from external light sources.

213.01.3 Optical Unit: The optical unit shall consist of lens, reflector, lamp socket and lamp. The optical unit and visor shall be designed as a unit to eliminate the return of outside sunlight from entering the unit from above the horizontal (known as sun phantom). The optical unit shall be designed and assembled so that no light can escape from one indication to another.

(1) Lens: The minimum values of luminous transmission and limits of chromaticity for traffic signal lenses shall be as defined in ANSI D 10.1. Each lens shall consist of a round 1-piece convex glass which, when mounted, shall have a visible diameter of at least 11 3/4 inches (295 mm) (for standard 12-inch (300 mm) signal section or a visible diameter of at least 7 3/4 inches (195 mm) for standard 8-inch (200 mm) signal section). The glass shall be free from bubbles, 3/16 inch to 5/16 inch (5 mm to 8 mm) thick, and smooth on the outside surface. The lens shall be marked to indicate the top or bottom. No lettering shall be visible on the lens from normal viewing position. The performance of solid color lenses shall be such that when installed in standard traffic signals (equipped with an approved lamp and reflector properly operated and focused), the appearance, candlepower distribution and intensity, when compensated for absorption due to the color, will at least equal the light distribution specified in ANSI D 10.1.

Arrow lenses shall be 12 inches (300 mm) in diameter and shall conform to the above lens specification. Arrow lenses shall be given one coat of black opaque enamel on the inside of lens of a thickness sufficient to hide the light of a 200 watt lamp placed behind it. Enamel shall be free from pin holes and applied so that when the lens is in use an arrow will be illuminated. Enamel shall be baked or fired into the glass and shall not peel or flake during service or when washed. The arrow shall not be visible except when lamp is illuminated.

An alternate method to produce an arrow indication is by use of a noncorrosive metal template affixed in the door housing in the same manner as the lens. The template shall conform and be retained next to the concave surface of the lens (inside face) to create clear outline of the arrow.

(2) Reflectors: Reflectors shall be rigidly mounted in the housing to assume proper alignment and arranged to be easily swung out of the housing and away from the door to provide access to the interior of the housing. An approved neoprene or rubber gasket shall be placed between the reflector and lens to ensure a dust tight seal. The gasket shall not be detrimental to the optical performance of the signal.

Reflectors shall be made of specular Alzak Aluminum spun or punched from metal not less than 0.025-inch thick (650 μ m), equipped with a bead or flange on the outer edge to stiffen the reflector and ensure trueness of shape. The thickness of the anodic coating shall be a minimum of 0.0003 inches (7.5 μ m). The reflecting surface shall be free of flaws, scratches, defacements or mechanical distortion.

(3) Lamps: Lamps shall comply with the following physical dimensions and design.

Type	Wattage	Rated Voltage	Lumen Output	Rated Life,h	Light Center, in. (mm)	Bulb Envelope	Operating Position
A	60	125	610	8,000	27/16 (62)	Clear A-19	Horizontal
B	135	125	1750	6,000	3 (75)	Clear A-21	Horizontal

The lamp base shall be brass with a built-in fuse to protect against filament arcing. The lamp filament shall be Type C11V or Type C9. The lamp shall have a minimum of 80 percent krypton gas concentration (volume per volume) for increased lumen output at stated wattage. Each lamp shall have the following information etched into the glass bulb the manufacturer's name, wattage, voltage rating, and average user operating hours. The lamp shall be permanently marked with the date of manufacturer. The lamp output shall meet or exceed the candlepower requirement when used in a traffic signal head at the rated initial lumens as specified by ITE standards for "Traffic Signal Lamps", 1980, and "Vehicle Traffic Control Signal Heads", 1984. The lamp shall not consume more than 5 percent above the stated wattage when operated at the rated voltage and producing the above referenced light output.

The lamp characteristics shall be tested by and recorded in a report from an approved independent testing laboratory.

- (4) Lamp Receptacle:** Lamp receptacles shall be made of heat resisting materials designed to properly position a traffic signal lamp with means for correct filament positioning. Lamp receptacles shall be designed to properly position a Type A lamp in the 8-inch lens section and Type B lamp in the 12-inch (300 mm) lens section. The receptacle shall be provided with a lamp grip to prevent the lamp from working loose due to vibration. Provisions shall be made to permit rotation of the lamp so that the lead wires are up and securely fastened, but shall not permit any change of position of the socket with respect to the optical center of the reflector. The metal portion of the lamp receptacle shall be brass or copper. A suitable dust-tight gasket (not cork) shall be placed between reflector and lamp socket.

Each lamp receptacle shall be provided with two color coded No. 18 or larger lead wires, Type TEW, 600-volt, AWM fixture wire with 3/64 inch (1.2 mm), 105°C rated thermoplastic insulation, securely fastened to the socket with sufficient length to reach the terminal block with the reflector fully open. The thermoplastic insulation shall, at 34°F (1°C), be capable of being wrapped 6 times around a 1-inch (25 mm) mandrel without damage to its insulating properties at rated voltage. Each lead shall have a terminal attached to its end, for connection to the terminal block in the signal housing with a screw driver.

- (5) Pedestrian Signals:** Pedestrian indications shall attract the attention of and be readable to the pedestrian both day and night and at all distances from 10 feet (3 m) to the full width of the area to be crossed. The indicators shall be rectangular and shall consist of the International Symbol Indications "WALKING PERSON" and the "RAISED HAND." When illuminated, the "WALKING PERSON" indication shall be lunar white and the "RAISED HAND" indication shall be Portland Orange meeting ITE standards. All but the symbols shall be obscured by an opaque material. When not illuminated, the "WALKING PERSON" and "RAISED HAND" indications shall not be distinguishable by pedestrians at the far end of the crosswalk they control.

213.01.4 Brackets: Brackets for the assembly of 2-way, 3-way and 4-way signal sections shall be constructed to have the center of the attachment points arranged on a 8-inch (200 mm) radius. Attachment to signal head shall be

made with 1 1/2-inch (38 mm) conduit or 3-bolt type fittings with a bolt length 1 1/2 inches (38 mm). Fittings at the center of the bracket shall have a removable lower plate for access to the wireway. The bracket at the supported end of the signal section shall be 1 1/2-inch (38 mm) conduit or a conduit with an equivalent inside clearance for wiring and a fitting with cover for access to the wire-way. The bracket at the opposite end of the section may be either the same as the top or solid. A set screw engaging a drilled hole shall be provided at each joint on the bracket where conduit type joints are used or an equivalent locking device shall be provided.

The attachment point for mounting on the bracket shall be a 2-inch (50 mm) opening. When slip-fit is used, the section shall come complete with the necessary nuts and washers for 1 1/2-inch (38 mm) conduit. Provisions shall be made for a positive lock to prevent accidental bracket rotation. Locking may be accomplished by means of serrations, detents, set screws, or similar devices. Friction locking will not be acceptable. An acceptable alternative to the 1 1/2-inch (38 mm) conduit will be a tri-stud type fitting with appropriate washer. Tri-stud length shall be 1 1/2 inches (38 mm). Unused openings of signal sections shall be closed with a standard waterproof plug for a 1 1/2-inch (38 mm) opening. The minimum length of the plug shall be 1 1/2-inches (38 mm). Steel plugs shall be galvanized in accordance with ASTM A 153. The exposed portions of plugs shall be painted to match the color of the signal heads.

Carbon steel components shall be galvanized in accordance with ASTM A 153.

213.01.5 Signal Mounts: Signal sections and beacon sections shall be as shown on the plans and shall be suitable for one of the following standard mounts, the type mount for each shall be specified in the plans.

- (1) **Support Cable Mount:** Support cable mounted signals shall come with a disconnect hanger and clamp described in Subsection 213.01.7.
- (2) **Pedestal Mount:** Pedestal mounts shall be furnished with a slip fitting for placement on a 4-inch (100 mm) inside diameter pipe pedestal having set screws for correct alignment of the signal. Provisions for the entrance of signal cables shall be incorporated into the design of the bracket assembly.
The bracket assembly shall incorporate a weatherproof terminal compartment or box with a removable cover allowing complete access. The box shall be a suitable size to accommodate, and shall come equipped with, a terminal strip with terminals equal to the number of signal indications in the signal heads plus one or more for common and for equipment ground. The terminal compartment shall be neat in appearance and shall be adjacent to or near the pedestal mount. In no case shall feed wires be required to pass through a signal section or face to reach the terminal compartment. A terminal compartment integral with the bracket will be permitted.
- (3) **Mast Arm Mount:** This mount shall be furnished and installed with an adjustable stainless steel strap or cable clamp, malleable clamp casting, tightening mechanism, vertical support tube, top and bottom signal head support with set screws, and bolts. The vertical support tube shall be a minimum of 5 feet (1.5 m) long.
Supporting brackets, trunnions, and fittings shall be made of cast aluminum, steel, or cast iron.
- (4) **Side Mount:** This mount shall be furnished for attaching brackets to vertical supports as shown on the plans. The bracket mounting hub shall accept 1 1/2-inch (38 mm) conduit and provide for a wire opening equivalent to a 1 1/2-inch (38 mm) conduit. For timber pole installation, the side mounts shall have a vertical entrance for 1-inch (25 mm) conduit.
- (5) **Flashing Beacon Signal Mount:** The flashing beacon signal shall attach to the support cable by a bracket as shown on the plans. The bracket shall be provided with a cable entrance adapter with provisions for balancing and securing the signal.

213.01.6 Backplates: Backplates shall be designed to fit the combination of sections of each signal face.

Backplates shall be flat aluminum alloy at least 0.05 inch (1.3 mm) (No. 18 gage) thick and shall withstand distortion in 70 mph (115 km/h) winds and shall be firmly attached to each signal face to withstand the above wind load and to permit the opening of any signal door independent from the other doors in the signal face. Width of backplates shall extend a minimum of 5 1/2 inches (140 mm) from the signal head in all directions or as specified on the plans. Backplates shall be furnished with an oven baked black enamel.

213.01.7 Disconnect Hanger for Traffic Signal Head: The hanger shall provide a means for connecting and disconnecting the signal head electrically and mechanically from signal support cable and span wire without use of tools. The hanger, with top and bottom attachments and clamps, shall not increase signal height from the span wire to the bottom of the signal by more than 6 inches (150 mm). The hanger shall be as shown on the plans and shall conform to the requirements of the clamp, housing and terminal block, plug, and adapter.

(1) Clamp: The clamp shall be capable of attaching to a 1/4 inch to 7/16 inch (6 mm to 11 mm) support cable and shall attach to or be integral with a balance adjusting device and a suitable weatherproof entrance for signal cable. The support cable clamp shall utilize a minimum of two "J" or "U" type bolts 3/8 inch (M10) or larger. A 5/8 inch (16 mm) clevis type suspension clamp shall be provided with a 5/8-inch (16 mm) diameter. The balance adjuster shall be suitable for mating with a clevis-type clamp having a horizontal clearance of 5/8 inch (16 mm) and pin of 5/8 inch (16 mm). All steel shall be galvanized in accordance with ASTM A 153.

(2) Housing: The housing and accessories shall be high-strength aluminum alloy and shall be equipped with a door of similar material. The door shall be held shut by a device operable with one hand without use of tools and shall not be easily removable. The door, when open, shall provide complete access to the interior of the housing and a device shall be included to hold the door open while working inside the hanger if it will not remain open.

The housing shall be equipped with two or more weatherproofed openings for signal cable entrance. The openings shall be equipped with suitable bushings for cable protection. Cable entrances shall be capable of accommodating three signal cables 1 1/16 inch (18 mm) in diameter. No cable opening shall be less than 1 inch (25 mm) in diameter. The housing shall be provided with a permanently mounted clamping device to prevent the cable from twisting. The clamping device shall not damage the cable jacket, insulation, or break wires.

The housing shall be provided with a 3 1/2-inch-by-3 1/2-inch (90 mm by 90 mm) cast aluminum flange adaptor as shown on the plans for connecting to the signal head or bracket.

(3) Terminal Block and Plug: An easily accessible pressure type terminal block shall be located in the housing and shall accommodate from twelve or eighteen separate lines, as specified. Each terminal shall be permanently numbered for identification, shall accommodate a minimum of two AWG No. 12 conductors, and shall be sufficiently rugged to permit tightening for proper electrical connection without damaging the wire. The terminal block shall be wired to a multi-circuit female jack connector mounted in the housing and aligned in accordance with the plans.

A minimum size No. 18 AWG wire, with 600-volt polyethylene or polyvinylchloride insulation, shall be used between the terminal strip and the jack connector. The numbered terminals on the terminal strip shall be wired to the corresponding numbered pin in the jack connector. A suitable male plug with clamp for the corresponding female jack connector shall be furnished and shall be equipped with 4 feet (1.2 m) of cabled leads for connection to the signal heads. Wire shall be No. 18 AWG, 600-volt polyethylene or polyvinylchloride insulated and neatly cabled.

213.02 TRAFFIC DETECTORS AND ASSOCIATED EQUIPMENT. Video Detector Device and

Connection, and Video Detection System shall be used for vehicle detection on actuated phases of signal operation. Pedestrian push-buttons shall be used as pedestrian detectors.

213.02.1 General: This specification sets the minimum requirements for a wide-area vehicle detection system that processes video images for vehicle presence, count, speed and other typical traffic parameters. The detection of vehicles passing through the field of view of an image sensor shall be available to a large variety of end user applications as simple contact closure outputs, data for traffic controller and other traffic data. This reflects the current real time detector or alarm states (on/off) or as summary traffic statistics that are reported locally or remotely. The contact closure outputs shall be provided to a traffic signal controller and comply to the NEMA (National Electrical Manufacturers Association) type C or D detector rack or a Type 170 input file rack standards.

The system architecture shall fully support networking of system components through a variety of industry standard and commercially available infrastructures that are used in the traffic industry. The serial data communications shall support direct connect, modem and multi-drop interconnects. Simple twisted pair wiring shall be supported to minimize overall system cost, improve reliability, utilizing existing infrastructure and ease of system installation and maintenance. Both video communications and serial data communications shall optionally be interconnected over long distances through repeat and daisy chain configurations. A single serial data communications multi-drop link on twisted pair shall extend up to 2 miles (3.2 Km) and include up to 24 units on a drop before the signal(s) must be repeated.

On the software application side of the network, the system shall be integrated through a client-server relationship. A communications server application shall provide the data communications interface between as few as one to as many as hundreds of machine vision processor (MVP) sensors and a number of client applications. The client applications shall either be hosted on the same PC as the communications server or may be distributed over a local area network of PC's using the industry standard TCP/IP network protocol. Multiple client applications shall execute simultaneously on the same host or multiple hosts, depending on the network configuration. The video detection system shall easily interface to an ethernet switch in the traffic control cabinet.

213.02.2 System Hardware: The machine vision system hardware shall consist of 4 components:

- (1) a color, 16x zoom lens, Machine Vision Processor (MVP) sensor;
- (2) a communication interface panel;
- (3) and optional cabinet interface module; and
- (4) a optional personal computer (PC).

The PC shall host the communication server and client applications to setup, program and monitor and detection performance.

The MVP sensor shall communicate with the cabinet interface module, communications interface panel and the various PC applications using the industry-standards TCP/IP network protocol. Additionally, one or more PCs shall communicate directly or remotely to a MVP sensor network where each MVP sensor has a unique Internet Protocol (IP) address. The MVP sensor network shall support communications over a mix of media, including PSTN, CDPD dedicated twisted-pair, fiber and wireless.

The cabinet interface module shall communicate directly with up to 8 MVP sensors and shall comply with the form factor and electrical characteristics of a NEMA type C or D detector rack or a 170 input file detector rack card. For a contact closure interface to a traffic controller or other device, this interface shall accept 8 contact closure inputs (usually red and green control signals) and provide 16 contact closure output to a traffic signal controller. For a SDLC

interface to a NEMA TS2 traffic controller, this interface shall display 32 phase colors and emulate up to 4 bus interface units (BIU).

The communication interface panel in the cabinet shall provide electrical termination of external cables for video, data and power to the MVP sensor. The communication interface panel shall provide transient protection to electrically protect equipment in the panel. The communications interface panel shall be available in two models: a 4-sensor model or a single-sensor model.

213.02.3 System Software: The MVP sensor's embedded firmware shall automatically perform a variety of diagnostic, installation, fault tolerant and vehicle detection operations. Vehicle detection shall be reliable, consistent and perform under all weather, lighting and traffic congestion conditions.

A software suite of client applications shall reside on the host client/server PC. The software suite shall support Microsoft Windows 98, later operating systems and ME, XP, NT, 2000. Client applications shall include:

- (1) Network Browser: Learn a network of connected modular cabinet interface units and MVPs then show the topology in a logical hierarchical relationship.
- (2) Detector Editor: Create and modify detector configurations to be executed on the MVP sensor.
- (3) Operation Log: Extract the MVP run-time operation log of special events that have occurred.
- (4) Software Installer: Reconfigure one or more MVP sensors with a newer release of embedded system software.
- (5) Video Player: Play streaming color video from any or all sensors connected to network. Video player shall also have the ability to go in to a video wall option which will divide the PC screen in as many sensors that are opened giving the user optimal viewing. The video player shall also be able to record and play back any or all sensors being viewed. Detection performance shall be able to viewed from the video player. In addition, speeds and classification of vehicles shall be able to be viewed from the video player.
- (6) Video Controller: Control the zoom, pan & tilt (optional) of the sensor it is controlling. Multiple sensors shall be able to be viewed or controlled at the same time. If multiple sensors are being viewed simultaneously, the video controller application shall allow the user to enlarge the screen in to a video wall option, which will split up the whole screen with the number of sensors being viewed.

An optional software developer's kit shall facilitate creation of custom client applications.

213.02.4 MVP Image Sensor: The MVP image sensor shall be integrated imaging color CCD array with wavelet CODEC technology hardware compression, optics, high-speed, image processing hardware and a general purpose CPU bundled into a sealed enclosure. The CCD array shall be directly controlled by the general purpose CPU, thus providing high video quality for detection that has virtually no noise to degrade detection performance. It shall be possible for the user to zoom the lens, as required for operation. It shall provide JPEG video compression software and a video compression co-processor so as not to interfere with detection performance while streaming video. The MVP shall provide direct real-time iris and shutter speed control. The MVP image sensor shall be equipped with an integrated 16x minimum zoom lens that can be changed using either configuration computer software or a hand-held controller. Each camera shall use an Ethernet addressing protocol so that each unit may be addressed via IP schema. Additionally, the camera shall have a failsafe mode in which detector calls are constantly placed to controller in the event of a malfunction.

The MVP sensor shall output full motion color video through the means of a differential video port in NTSC format. The differential video is transmitted over a single twisted pair. Real-time detector performance shall be observed by viewing the video output from the sensor with overlaid flashing detector to indicate the current detection state (on/off). The MVP shall also have the option of being attached to a pan/tilt driver that allows the user to pan, tilt and zoom the camera from within the same software package for video detection. The driver shall be able to come back to the original detection position within 0.2° after panning and tilting.

213.02.5 Power: The MVP sensor shall operate on 24 VAC, 50/60 Hz at a maximum of 20 watts. The camera and processor electronics shall consume a maximum of 10 watts and the remaining 15 watts shall support and enclosure heater.

213.02.6 Video Outputs: The MVP shall provide video output from the communications interface panel for real-time NTSC or PAL display on a monitor or PC over standard coax cable. The software shall also display streaming video as part of the user software based on JPEG video compression or optimal hardware-based wavelet video compression. The streaming video shall be recordable as a data file on the PC for later playback and editing.

Streaming video from multiple MVPs shall be simultaneously displayable as a group or video wall. Streaming video shall be possible at communication speeds from 9.6k Baud to 230k Baud.

213.02.6 Detection Types: The MVP shall be able to be programmed with a variety of detector types that perform specific functions. The general functions performed by the detectors shall:

- (1) Include presence/passage detection of moving and stopped vehicles.
- (2) Enable detection based on the direction of travel or based on when a moving vehicle stops.
- (3) Measuring vehicle speed and length and provide 5 classes of vehicles based on length.
- (4) Determine counts, either lane by lane or cumulative.
- (5) Speed alarm detectors:
 - (a) Output alarm on each fast vehicle, ignoring vehicles of length of less than the user defines.
 - (b) Output alarm based on the average number of vehicles the user enters and the upper and lower speed thresholds that the user defines.
 - (c) Output alarm based on the average speed over a user defined time frame.
 - (d) Output alarm based on a user defined percent increase or decrease over a speed limit.

213.02.7 Detection Zone Programming: Placement of detection zones shall be by means of a supervisor computer (PC) operating in the Windows 98, 2000 or Windows NT graphical environments, a keyboard and a mouse. The VGA monitor shall be able to show the detection zones superimposed on images of traffic scenes. The detection zones shall be created by using a mouse to draw detection zones on the supervisor computer's VGA monitor. Using a mouse and the keyboard it shall be possible to place, size and orient detection zones to provide optimal road coverage for vehicle detection. It shall be possible to download detector configurations from the supervisor computer to the MVP, to retrieve the detector configuration that is currently running in the MVP and to back up detector configurations by saving them to the supervisor computer's removable or fixed disks.

The supervisor computer's mouse and keyboard shall be used to edit previously defined detector configurations to permit adjustment of the detection zone size and placement, to add detectors for additional traffic applications, or to reprogram the sensor for different traffic applications or changes in installation site geometry or traffic rerouting.

213.02.8 Optimal Detection: The video detection system shall optimally detect vehicle passage and presence

when the MVP sensor is mounted 30 feet (10M) or higher above the roadway, when the image sensor is adjacent to the desired coverage area and when the distance to the farthest detection zone locations are not greater than ten (10) times the mounting height of the MVP. The recommended deployment geometry for optimal detector also requires that there be an unobstructed view of each traveled lane where detection is required. Although optimal detection may be obtained when the MVP is mounted directly above the traveled lanes, the MVP shall not be required to be directly over the roadway. The MVP shall be able to view either approaching or receding traffic or both in the same field of view. The preferred image sensor orientation shall be to view approaching traffic since there are more high contrast features on vehicles as viewed from the front rather than the rear. The MVP sensor placed at a mounting height that minimizes vehicle image occlusion shall be able to monitor a maximum of 6 to 8 traffic lanes simultaneously.

213.02.9 Data Collection: The MVP sensor shall optionally store cumulative traffic statistics, internally in non-volatile memory, for later retrieval and analysis. The following data types are available to be stored in time increments from a cycle to one-hour increments:

1. Average Flow Rate
2. Total Volume Count
3. Arithmetic Mean Speed
4. Vehicle Class Count
5. Average Time Headway
6. Average Time Occupancy
7. Level of Service
8. Space Mean Speed
9. Space Density
10. Density

The above data types shall also be available to view viewed real-time.

213.02.10 Modular Cabinet Interface Unit (Mini Hub II): The modular cabinet interface unit shall provide the hardware and software means for up to 8 MVP sensors to communicate real-time detector states and alarms to a local traffic signal controller. It shall comply with the electrical and protocol specifications of NEMA TS-1. The card shall have 1500 V RMS isolation rack logic ground and street wiring.

The modular cabinet interface unit shall be a simple interface card that plugs directly into an enclosure matching a NEMA type C or D detector rack. The modular cabinet interface unit with enclosure shall be a shelf-mounted unit. The modular cabinet interface unit shall provide 8 phase inputs and 16 detector outputs. In a TS-2 environment, the mini-hub shall connect to the traffic controller via a SDLC cable provided by the video detection manufacturer. The SDLC cable shall transmit all the inputs and outputs from the MVP.

213.02.11 Communications Interface Panel: The communications interface panel shall support one to 4 MVPs. The communications interface panel consists of a predefined wire termination block for MVP power, data and video connections, a power transformer for the MVP, electrical surge protectors to isolate the modular cabinet interface unit and MVP and an interface connector to cable directly to the modular cabinet interface unit. The connection from the MVP(s) to the communications interface panel shall be via 5 ½ twisted pair with an overall shield and not coaxial cable. Manufacturer shall either supply their recommended twisted pair cable for one continuous run from MVP to communications interface panel. Splicing of the cable will not be allowed. The interface panel shall provide power for 4

MVPs through 4 step-down transformers, taking local line voltage and producing 28 VAC, 50/60 Hz, at about 30 watts. A ½ amp slow-blow fuse shall individually protect the step-down transformers.

213.03 LOOP DETECTOR DEVICE: When permitted, Loop Detector Device and Connection may be used for vehicle detection on actuated phases of signal operation.

213.03.1 Loop Detectors: Detector units for signalized intersections are included as part of DOTD Traffic Control Standard 18A. Detector units required at remote vehicle detection locations shall comply with NEMA TS1, Section 15, with or without delay and extension timing as specified. Two types of inductive detector units are specified, those with and without the ability to delay and extend a call, NEMA Type I and Type I T. Detector units shall be suitable for accurate detection of vehicles from motorcycles to tractor-trailer combinations which ordinarily travel public streets and highways with sufficient conductive material, suitably located to permit recognition and response by the detector system. Detector units shall also comply with NEMA TS1, Section 15.2.6.

- (1) Size and Case:** The amplifier case shall be constructed of rugged metallic material with a protective coating. A removable cover shall be provided to allow access to internal circuitry. The cover shall be removable with hand tools.
- (2) Connectors, Switches, and Fuses:** Switches, connectors, and fuses shall be located on the front of the unit.
 - (a)** Each switch shall be permanently labeled to identify its function. Each position shall be permanently labeled to identify its mode of operation. Each mode of operation shall be simple to program with one switch position assigned to one function.
 - (b)** A single connector shall be required on the front of the unit to comply with NEMA TS1, Section 15.2.28.1. This connector shall mate with cable connections MS 3106A-18-1S.
 - (c)** Plug wiring shall be as follows:

PIN	FUNCTION
Pin A	AC(-)
Pin B	Relay Common
Pin C	AC(+)
Pins D & E	Loop Leads
Pin F	Relay (N.O.)
Pin G	Relay (N.C.)
Pin H	Chassis Ground
Pin I	Spare
Pin J	Delay Override

¹ No pins shall be used for any other purpose than those listed above.

- (d)** Fuseholders shall be permanently labeled identifying the size of the fuse.
- (3) Electrical Characteristics:**

- (a)** Detector unit outputs shall be a relay type as referenced in NEMA TS1, Section 15.2.29.1. The output operation shall be indicated by a high intensity light emitting diode.
- (b)** Color coding for the wire shall be as follows:

Function	Color Code
Detector Wiring	Not Specified
AC(+)	Black
AC(-)	White
Relay Common	White/Black Stripe
Ground	Green

(c) The operation of the detector unit shall comply with NEMA TS1, Section 15.2.1. In addition, the detector unit shall return to a new inductance value following an excessively large inductance change.

(d) When sensor loop and loop lead-in network falls outside the specifications in NEMA TS1, Section 15.2.13, the detector shall generate a fail safe continuous output in both presence and pulse modes. The continuous output shall remain until the memory is cleared by removing power or resetting.

(e) When specified, the detector unit shall have the ability to delay and extend a call to the controller. The Delay/Extension operations shall comply with NEMA TS1, Section 15.2.24.

(1) The delay time shall begin when a vehicle enters the detection area until the call relay is closed representing an activation and shall be selectable in the range between 0 and 30 seconds.

(2) The extension time shall begin timing when the vehicle leaves the detection area, continuing the activation for the selected time. The time shall be selectable in the range of 0 to 7 1/2 seconds.

(4) The detector unit shall have at least three selectable frequencies which shall be visible at all times on the front of the detector unit.

(5) The Sensitivity Control shall comply with NEMA TS1, Section 15.2.14 and Section 15.2.15. There shall be at least three selectable sensitivity ranges located on the front of the detector unit. The sensitivities shall be nominally 0.02 percent, 0.08 percent, and 0.32 percent change in total loop inductance.

(6) The modes of operation shall comply with NEMA TS1, Section 15.2.17. There shall be two presence modes and one pulse mode. The selected mode shall be indicated at all times on the front of the detector unit.

(a) Long presence mode shall continue to detect the same vehicle within the detection area for at least 3 1/2 minutes for a Class I type test vehicle.

(b) Medium presence mode shall continue to detect the same vehicle within the detection area for at least 20 seconds for a Class I type test vehicle.

(7) Fail Safe: The detector shall operate with the sensor loop shorted to ground or of poor quality. The unit shall generate a continuous call when returning failed sensor loop, failed detector unit, or power failure.

(8) Loop Detector Sealant: The loop detector sealant shall comply with Table 213-1:

**Table 213-1
Loop Detector Sealants**

Physical Property	Test Method	Hot Applied	Cold Applied					
			Single Component		Two Component			
					Rapid Set		Slow Set	
			Self Leveling	Non-Sag	Self Leveling	Non-Sag	Self Leveling	Non-Sag
Total Solids by weight,%, Min.	ASTM D 2834		60	60	60	60	60	60
Tack Free Time, hr, Max.	ASTM C 679		4	4	2	2	4	4
Rheological Properties	ASTM C 639 Type I		Smooth surface		Smooth surface		Smooth surface	
Slump, mm	ASTM D 2202			7.6		7.6		7.6
Extrusion Rate, mL/min, Min.	ASTM D 1183		50	50				
Hardness shore A, Min.	ASTM D 2240		10	10	10	10	10	10
Penetration @ 25°C, Min.	ASTM D 5	60						
Softening Point, °C, Min.	ASTM D 36	82						
Asphalt Compatibility ¹	ASTM D 5239	pass	pass	pass	pass	pass	pass	pass
Pot Life, minutes, Min.	ASTM C 881				12	12	30	30
Dielectric Strength, 60 Hz, Short Time test, Electrode I in air @ 25°C kV/mm, Min.	ASTM D 149	13.8	13.8	13.8	13.8	13.8	13.8	13.8
Flex @-7°C, inch, 90° Bend	ASTM D 5329	pass	pass	pass	pass	pass	pass	pass

¹ Not applicable when used to seal portland cement concrete pavement.

213.03.2 Pedestrian Pushbuttons: Pedestrian pushbuttons shall consist of a direct push type button and single momentary contact switch in a cast metal housing on which shall be attached the pushbutton sign shown in the plans. The cast metal housing shall include conduit fittings for 1/2-inch (13 mm) conduit on the back and bottom. Operating voltage for pedestrian pushbuttons shall not exceed 24 volts DC.

The assembly shall be weatherproof and constructed so that it will be impossible to receive an electrical shock under any weather condition. When a pedestrian pushbutton is attached to a pole, the housing shall be shaped to fit the curvature of the standard or post to which it is attached to provide a rigid installation. When a pushbutton is to be mounted on top of a 2 1/2-inch (65 mm) post, the housing shall be provided with a slip-fitter fitting and screws for securing rigidly to the post.

213.04 TRAFFIC SIGNAL HARDWARE AND EQUIPMENT.

- (a) **General:** This Subsection defines the general requirements that shall apply to all hardware and equipment not specifically listed. When design tests are specified, documentation may be provided indicating that such tests have previously been satisfactorily completed.
- (b) **Miscellaneous Hardware:** Screws, nuts, and lock washers shall be stainless steel or galvanized in accordance with ASTM A 153. No self tapping screws shall be used unless approved.
- (c) **Pedestal Anchor Bolts:** Steel anchor bolts shall be as shown on the plans and shall be fitted with one hex nut and one washer. Nuts, washers, and anchor bolts shall be galvanized in accordance with ASTM A 153.
- (d) **Support Cable:** Support cable for interconnect and detector support cable shall be 1/4-inch (6 mm) outside diameter and signal support cable and guy wire shall be 3/8-inch (18 mm) outside diameter and shall comply with ASTM A 475, 7-strand Siemens-Martin grade with Class A coating.
- (e) **Guy Components:** Guying components and hardware shall be galvanized in accordance with ASTM A 123 and ASTM A 153. Guy clamps shall be steel, 3-bolt type, 6 inches (150 mm) in length, and of proper strand size to fit both sizes of cable. Clamp bolts shall have an upset shoulder fitting into the clamp plate.
- (f) **Traffic Signal Cable:** The cable shall be 600 volt insulated cable. Filler material, when used, shall be non-metallic, moisture resistant, non-hydroscopic, non-wicking, and non-absorbent. The conductors that are to be marked with tracer in addition to the solid color shall have the tracer as part of the insulation, ink marking is not acceptable. The outside jacket shall be smooth and shall not display patterns of the conductor lay on the outside of the jacket. The traffic signal cable shall be No. 14 AWG solid conductor. Interconnect cable shall be No. 16 AWG in the 24 conductor and 12 AWG in the 7 conductor. All material, color code, and testing shall comply with IMSA 20-1. The interconnecting cable between intersections for closed loop and telemetry operation shall be 6 pair IMSA 20-6. Loop lead-in cable shall be tinned No. 14 AWG stranded conductor, twisted pair with an overall shield. The cable shall comply with IMSA 50-2. Loop detector wire shall comply with IMSA 51-3 and shall be No. 16 AWG-19 strands/No. 29 AWG copper. Insulation shall be 0.080-inch XLPE.
- (g) **Electrical Junction Box:** Junction boxes shall be constructed of Class M concrete, cast iron or epoxy/sand composite, as shown on the plans. Class M concrete shall conform to Section 901. Reinforcement shall consist of welded wire fabric, 4-inch-by-4-inch (100 mm by 100 mm) No. 4/4 complying with Section 1009. Pull boxes may be cast-in-place or precast. Epoxy/sand composite boxes shall be manufactured in accordance with the plans. The composite material shall have a minimum compressive strength of 11,000 psi (75 MPa). The manufactured box shall have a minimum compressive strength of 5,000 pounds (300 kg) over any 100 square inch (64,500 sq mm) area on the cover when installed on the box.

213.05 POLES FOR TRAFFIC SIGNAL SYSTEMS.

- (a) **Pedestal Support Signal Poles:** The pole shall be in accordance with the plans. The base of the pedestal shall be cast iron or aluminum and shall be at least 16 inches (400 mm) wide at the bottom, at

least 16 inches (400 mm) high and shall be octagonal. The upper end of the base shall be threaded to receive a 4-inch (100 mm) diameter pipe shaft. The base shall be designed so that it may be fastened to the foundation using 5/8-inch-by-16-inch (16 mm by 400 mm) anchor bolts located 90 degrees apart on the circumference of a circle 12 3/4 inches (325 mm) in diameter.

The base shall contain a removable door to allow access to anchor bolts and to permit cable splicing. This door shall be fastened to the base using a hex head stainless steel screw into a threaded hole in the base. The shaft shall be 4 1/4 inches (108 mm) in inside diameter welded steel tubing with a minimum 1/8-inch (3 mm) wall thickness. The lower end of the shaft shall be welded to a 6-inch (150 mm) nipple to screw into the base. This shaft shall be a single piece of tubing. Pedestals shall be finished with at least one coat of rustproofing primer, applied to a clean surface and one coat of green enamel. The length of pedestal, shaft plus base, shall be a minimum of 8 feet (2.4 m).

(b) Steel Signal Support Pole:

(1) General: Poles and fittings shall be in accordance with the plans and shall be galvanized in accordance with ASTM A 123 and A 153. Poles shall be suitable for a minimum horizontal load of 4,000 pounds (1800 kg) applied 1 foot (300 mm) below the top of pole.

(2) Pole Shaft: The pole shaft shall have a minimum base diameter of 11 inches (280 mm) and a maximum base diameter of 11 3/4 inches (295 mm). The pole shaft shall be tapered to approximately 7-inch (175 mm) diameter at the top. The pole shaft may have a round or octagonal cross section. A cap shall be used to cover the pole shaft top. The pole shall be designed so that its maximum deflection is as shown in Table 213-2.

**Table 213-2
Steel Pole Deflection**

Pole Length, ft (m)	Maximum Deflection, in/100 lb (mm/50 kg)
26 (7.9)	0.25 (7.0)
28 (8.5)	0.30 (8.4)
30 (9.1)	0.38 (10.6)

(3) Handholes and Bosses: A hand hole shall be provided approximately 18 inches (450 mm) above the base with approximate dimensions of 4 inches by 6 1/2 inches (100 mm by 165 mm) and cover shall be provided. The cover shall be restrained to the pole with a 15 inch (380 mm) No. 35 stainless steel chain fastened to the cover and to the inside of the hand hole so that the chain will be inside the pole after the cover is installed on the pole. There shall be no sharp edges on the cover, in the hand hole, or in the pole. The cover shall have the manufacturer's name and the pole height stenciled on it, readable from the outside of the pole. The stencil shall be legible after galvanizing.

The hand hole strain bar shall be formed to provide a mechanical lock against the hand hole to prevent turning. No obstructions shall be in the hand hole with the cover removed. A grounding nut (1/2 inch (13 mm)-13NC) shall be welded to the inside of the shaft 90 degrees left and horizontal from the hand hole. A grounding lug shall be provided with each pole.

All poles shall have 1 inch (25 mm) and 3 inch (75 mm) bosses centered on a horizontal line 18 inches (450 mm) from the base and 18 inches (450 mm) from the top. When facing the bosses, the 1-inch (25 mm) boss shall be 35 degrees (± 3) to the right of the 3-inch (75 mm) boss. The 3-inch (75 mm) boss shall be located 180 degrees from the hand hole. The bosses at the top of the pole shall be

in line with the bosses at the bottom. The poles shall be shipped with all bosses plugged using galvanized steel conduit plugs installed to full thread depth. On octagonal poles the 3-inch boss shall be centered on one face that is parallel to one edge of the base plate.

(c) Steel Signal Support Standards and Mast Arms:

- (1) General:** Standards, mast arms and fittings shall be galvanized in accordance with ASTM A 123 and A 153. The height of poles, shaft dimensions, and wall thickness shall meet the design requirements and mounting height of traffic signals set forth in the project specifications and in the plans. The length of arms shall be as shown on the plans. Standards shall consist of straight or uniformly tapered shafts, cylindrical or octagonal in cross section, having a base welded to the lower end with anchor bolts. Castings shall be clean and smooth with details well defined and true to pattern. Mechanical control shall prevent the arm from twisting on the shaft. Friction is not acceptable. Mast arms shall be compatible with poles in materials, strength, shape, and size. Mast arms shall slip fit on the shaft.
- (2) Hand Holes and Bosses:** A hand hole shall be provided for access to the wireway at the union of the arm and the pole shaft. Bosses shall be 1 1/2 FPT in the mast arm and set at 45 degrees from horizontal (downward rotation at the center of the boss, 0 degrees toward the arm top). Bosses shall be located a horizontal distance of 10 feet (3 m) apart, the first located 16 inches (400 mm) from the top of the arm. The number of bosses required is listed in Table 213-3.

Table 213-3
Steel Signal Support Standards

Shaft		Shaft Base Plate	
Arm Length, ft (m)	Number of Bosses	Diameter, Inches, (mm) Max.	Bolt Circle, Inches, (mm) Max.
15 -20 (3.0-6.5)	2	10 (250)	14 1/2 (370)
25-30(7.5-9.5)	3	12 (300)	15 (375)
35-50 (10.5-15.5)	4	13 (330)	16 (400)

- (3) Hanger Plate:** A hanger plate and horizontal boss shall be at the tip of the arm. The arm shall have an up-sweep design. Design load on the arm shall be sufficient to place a signal head at each boss.
- (4) Design Requirements:** For establishing the loads, applied to each structure, the weights and projected areas of Table 213-4 shall be used for traffic signal heads.

Table 213-4
Steel Signal Support Standards Design Requirements

Type ¹	Design Weight (Mass) Per Signal, pounds ¹ (kg ¹)	Projected Area Per Signal	
		Less Backplates, square feet (sq m)	Backplates, square feet (sq m)
1-Way, 3 Section	62 (28)	4.8 (0.446)	8.9 (0.827)
1-Way, 4 Section	76 (34.5)	6.6 (0.613)	11.2 (1.041)
2-Way, 3 + 3 Sections	126 (57)	8.7 (0.808)	12.2 (1.133)
3-Way, 3+3+3 Sections	179 (81)	13.35 (1.240)	15.6 (1.449)
4-Way, 3+3+3+3 Sections	235 (106.5)	13.2 (1.226)	15.6 (1.449)

¹When signal heads of a type different from that shown above are used, the weights (mass) and projected area shown above shall be increased for the equipment proposed for use. Adjusted values shall be based on the use of 12-inch (300 mm) diameter lenses and backplates (when used) extending 5 inches (125 mm) beyond signal enclosure.

- (5) Standard Shaft:** The standard shaft base shall have a minimum diameter of 11 inches (280 mm). Mast arm standards shall be provided with a transformer type base. Each pole shall be bolted to transformer base with four hex head bolts with two washers and one nut for each bolt.
- (6) Transformer Base:** The transformer base shall be approximately 20 inches (500 mm) high. The top of the transformer base shall have four 1 1/2-inch-by-2 1/2-inch (38 mm by 64 mm) slots for bolting the pole to the transformer base. The 2 1/2-inch (64 mm) dimension of the slot shall be centered on and perpendicular to a 13 1/2-inch (340 mm) bolt circle.
A removal panel on the side of the transformer base shall be provided for access to the base. A 1/2-inch (13 mm)-13NC grounding nut shall be provided 90 degrees left of this panel. A grounding lug shall be provided with each pole. The bottom of the transformer base shall fit a 16-inch (400 mm) bolt circle using four 1 3/4-inch (45 mm) bolts supplied with each pole. These bolts shall conform to these specifications and plan details with exception that the cap nuts shall be replaced with the regular hex nuts. The transformer base shall be capable of being rotated 360 degrees.
- (7) Wireways:** The pole shaft and mast arm shall be suitable for wireways throughout their length.
- (8) Identification:** The pole shaft, mast arm and arms, and transformer base shall have a matching serial number. Serial numbers shall be assigned by the Traffic Engineering and Services Administrator or shown on the plans.
- (d) Anchor Bolts for Steel Signal Support Poles and Standards:** Anchor bolts shall be supplied in accordance with the standard details and shall be 1 3/4 inch (45 mm), 5 NC thread with a yield strength of 105,000 psi (724 MPa). and hot dipped galvanized for the top 12 inches (300 mm) and shall comply with ASTM A687-B7 or ASTM A193-B7. One additional anchor bolt shall be supplied by the contractor at no cost for acceptance testing by the City.
- (e) Loop Detector Sealants:** Loop detector sealant shall be as specified in Subsection 213.03.1(8).
- (f) Timber Wood Poles:** Poles shall comply with Section 206.

SECTION 214

THIS SECTION LEFT BLANK

SECTION 215

SIGNS AND PAVEMENT MARKINGS

215.01 GENERAL REQUIREMENTS. The materials shall comply with these specifications, the plans and the MUTCD. When directed, the contractor shall furnish and prepare samples for testing in accordance with City instructions.

215.02 METALS.

(a) Ferrous Metals:

(1) Structural Steel: Structural steel for posts, stringers, framing and miscellaneous steel shall comply with ASTM A 709, Grade 36 (ASTM A 709M, Grade 250). Steel shall be galvanized in accordance with Subsection 210.8.

(2) Steel Pipe: Steel pipe or tubing for structures shall be Schedule 40 (STD) complying with ASTM A 53, Type E or Type S Grade B, or hot formed tubing complying with ASTM A 36 (ASTM A 36M) and ASTM A 501.

(3) Steel Posts for Small Signs, Markers and Delineators: Posts shall be steel of the flanged channel type shown on the plans, galvanized after fabrication in accordance with Subsection 210.8. Before fabrication, posts shall be within 3.5 percent of the specified weight (mass). Posts shall be fabricated from steel complying with either ASTM A 499, Grade 60 with chemical properties conforming to ASTM A 1 for 91-lb/yd (45 kg/m) or heavier rail steel, or ASTM A 576, Grade 1080 with 0.10 percent -0.20 percent silicon. Holes 3/8 inch (10 mm) in diameter shall be drilled or punched through the middle of each post on one inch (25-mm) centers for at least 36 inches (900 mm) from the top of each post.

(b) Aluminum Alloy: Structural members shall be aluminum complying with ASTM B 221 (ASTM B 221M) or ASTM B 429, Alloy 6061-T6. Miscellaneous aluminum shall comply with ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

(c) Fittings:

(1) Structural Bolts, Nuts and Washers: High strength bolts shall be ASTM A 325 (ASTM A 325M), and other bolts shall be ASTM A 307, Grade A or Grade B. Bolts shall have hexagonal heads and be supplied with two flat and one lock washer and hexagonal-head nut. Bevel washers, where required, shall be wrought steel. Bolts, nuts and washers shall be galvanized in accordance with ASTM A 153 or by an approved mechanical galvanizing process complying with ASTM B 695 that provides the same coating thickness.

Anchor bolts shall be ASTM A 709, Grade 250 (ASTM A 709M, Grade 36) steel except the maximum tensile strength shall be 88,000 psi (605 MPa) and galvanized in accordance with Subsection 210.8 unless otherwise specified. Stainless steel bolts shall comply with ASTM A 320 (ASTM A 320M), Grade B 8, annealed or approved equal.

(2) Fasteners: Fasteners used in fabricating sign faces, including splice plates for joining two panels, sills and border angles, and attaching route marker shields shall be 1/4 inch (6 mm) aluminum blind rivets that provide positive mandrel retention. These rivets shall have a minimum tensile strength of 875 pounds (397 kg) and a minimum sheer strength of 850 pounds (386 kg).

Fasteners used in attaching demountable legend to sign faces (except for shields) shall be 1/8 inch (3 mm) diameter blind rivets manufactured from aluminum alloy complying with ASTM B 316 (ASTM B 316M), Alloy 1100-H14. Fasteners for delineator, object marker and milepost assemblies shall be vandal resistant and will be subject to approval prior to use.

215.03 FLEXIBLE POSTS. Flexible posts for small signs, markers and delineators shall be approved products listed in QPL 39.

215.04 SIGN PANELS.

(a) Permanent Sign Panels: Flat panels shall be aluminum sheets or plates complying with ASTM B 209, Alloy 6061-T6 or Alloy 5052-H38. Extruded aluminum panels shall comply with ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

(b) Temporary Sign Panels: Panels shall be made from sheet aluminum, sheet steel, wood or plastic (barricades only).

(1) Aluminum: Aluminum sheeting shall be 0.080 inch (2 mm) thickness complying with ASTM B 209 (ASTM B 209M), Alloy 6061-T6 or Alloy 5052-H38.

(2) Steel: Steel panels shall be 16 gage (1.6 mm) continuous coat galvanized steel sheeting complying with ASTM A653, Coating Z275 (ASTM A 653M, Coating G 90).

(3) Wood: Plywood sheeting of exterior type Grades either High Density Overlay or Medium Density Overlay, are acceptable for use provided the following requirements are met.

Panels shall be a minimum of 5/8 inch (15 mm) thick and shall comply with the latest American Plywood Association specifications and be identified with the APA edge mark or back stamp to verify inspection and testing. Prior to application of reflective sheeting, the surface shall be abraded with steel wool or fine sandpaper, and wiped thoroughly clean. The surface shall be allowed to dry a minimum of 8 hours prior to application of sheeting. Cut edges of plywood panels shall be sealed with an approved aluminum pigmented polyurethane sealer.

(4) Plastic (barricades only): Plastic panels shall consist of high density polyethylene and shall be sufficiently rigid to maintain a flat surface.

215.05 REFLECTIVE SHEETING. Reflective sheeting shall be one of the following types as specified on the plans and complying with ASTM D 4956 except as modified herein. The sheeting shall be an approved product by the City's Traffic Engineer.

Type I - A medium-intensity retroreflective sheeting referred to as "engineering grade" and typically enclosed lens glass-bead sheeting.

Type II - A medium-high-intensity retroreflective sheeting sometimes referred to as "super engineering grade" and typically enclosed lens glass-bead sheeting.

Type III - A high-intensity retroreflective sheeting, that is typically encapsulated glass-bead retroreflective material.

Type VI - An elastomeric-high-intensity retroreflective sheeting without adhesive. This sheeting is typically a vinyl microprismatic retroreflective material.

DOTD Type VII - A super-intensity retroreflective sheeting having high retroreflectivity values at wide entrance angles of +45° and +60°. This sheeting is typically an unmetalized microprismatic retroreflective element material.

DOTD Type VIII - A super-intensity retroreflective sheeting having optimized performance over a broad range of observation angles. This sheeting is typically an unmetalized microprismatic retroreflective element material.

(a) Adhesive Classes: The adhesive required for retroreflective sheeting shall be Class I (pressure sensitive) or Class 2 (heat activated) as specified in ASTM D 4956.

(b) Identification Marks: Type II sheeting shall be distinguished by integral identification marks that cannot be removed or affected by physical or chemical methods without causing damage to the sheeting. The markings shall be inconspicuously placed on 12-inch (300-mm) centers and shall be visible from a distance of not more than 3 feet (1.0 m).

(c) Alternate Sheeting Types:

(1) DOTD Type VII: Minimum Coefficients of Retroreflection shall be as specified in Table 215-1. Luminance factors shall be as specified in Table 215-2.

**Table 215-1
Coefficients of Retroreflection for DOTD Type VII Sheeting ¹**

Observation Angle, degrees	Entrance Angle, degrees	White	Yellow	Red	Blue	Green	Orange	Flour. Orange
0.2	-4	800	660	215	43	80	300	200
0.2	+30	400	340	100	20	35	150	120
0.2	+45	145	85	25	7.6	12	50	50
0.2	+60	35	23	6.6	1.0	2.0	10	10
0.5	-4	200	160	45	9.8	20	100	80
0.5	+30	100	85	26	5.0	10	50	50
0.5	+45	75	60	18	2.8	6.0	20	20
0.5	+60	30	20	6.0	2.0	2.0	10	6.0

¹Minimum Coefficient of Retroreflection (RA) (cd lx-l m-2)

**Table 215-2
Luminance Factor (Y%)(Daytime Luminance)**

Color	Minimum	Maximum
White	40	---
Yellow	24	45
Red	3.0	15
Blue	1.0	10
Green	3.0	9.0
Orange	12	30
Florescent Orange	30	---

(2) DOTD Type VIII: Minimum Coefficients of Retroreflection shall be as specified in Table 215-3. Luminance Factors shall be as specified in Table 215-2.

Table 215-3
Coefficients of Retroreflection for DOTD Type VIII Sheeting ¹

Observation	Entrance	Rotation	White	Yellow	Red	Blue	Green
0.20	-4	0	430	350	70	20	45
0.33	-4	0	300	250	53	15	33
0.50	-4	0	250	200	46	10	25
1.00	-4	0	80	65	14	4.0	10
0.20	30	0	235	190	39	11	24
0.33	30	0	150	130	25	7.0	18
0.50	30	0	170	140	25	7.0	19
1.00	30	0	50	40	11	2.5	5.0
0.20	40	90	150	125	25	6.0	15
0.33	40	90	85	75	14	4.0	8.0
0.50	40	90	35	30	4.0	1.5	3.5
1.0	40	90	20	13	5.0	0.7	2.0

¹ Minimum Coefficient of Retroreflection (RA) (cd lx -1 m -2)

(d) Accelerated Weathering: Reflective sheeting, when processed, applied and cleaned in accordance with the manufacturer's recommendations shall perform in accordance with the accelerated weathering standards in Table 215-4.

**Table 215-4
Accelerated Weathering Standards 2**

Type	Retroreflectivity ¹				Colorfastness ³	
	Orange		All colors, except orange		Orange	All colors, except orange
I	Not used		2 years	50 ⁴	Not used	2 years
II	I year	70 ⁵	Not used		I year	3 years
III	I year	70 ⁶		80 ⁶	I year	3 years
III (for drums)	I year	70 ⁶	I year	80 ⁶	I year	I year
VI	1/2 year	50	1/2 year	50	1/2 year	1/2 year
DOTD Type VII	I year	50 ⁷	Not used		I year	Not used
DOTD Type VIII	Not used		3 years	80 ⁸	Not used	3 years

¹ Percent retained retroreflectivity of referenced table after the outdoor test exposure time specified.

² At an angle of 45° from the horizontal and facing south in accordance with ASTM G7.

³ Colors shall conform to the color specification limits of ASTM D4956 after the outdoor test exposure time specified.

⁴ ASTM D4956, Table 1.

⁵ ASTM D4956, Table 3.

⁶ ASTM D4956, Table 4.

⁷ Table 215-1.

⁸ Table 215-3.

(e) Performance: Reflective sheeting for signs, when processed, applied and cleaned in accordance with the manufacturer's recommendations shall perform outdoors in accordance with the performance standards in Table 215-5.

Table 215-5

Reflective Sheeting Performance Standards

Type	Retroreflectivity ¹ -- Durability ²				Colorfastness ³
	Orange		All colors, except orange		
I	Not used		7 years	40 ⁴	3 years
II	3 years	70 ⁵	Not used		3 years
III	3 years	70 ⁶	10 years	70 ⁶	3 years
DOTD Type VII	3 years	50 ⁷	Not used		3 years
DOTD Type VIII	Not used		7 years	50 ⁸	3 years

¹ Percent retained retroreflectivity of referenced table after installation and the field exposure time specified.

² All sheeting shall maintain its structural integrity, adhesion and functionality after installation and the field exposure time specified.

³ All colors shall conform to the color specification limits of ASTM D4956 after installation and the field exposure time specified.

⁴ ASTM D4956, Table 1.

⁵ ASTM D4956, Table 3.

⁶ ASTM D4956, Table 4.

⁷ Table 215-1.

⁸ Table 215-3.

(f) Temporary Signs, Barricades, Channelizing Devices, Drums and Cones: Reflective sheeting for temporary signs, barricades and channelizing devices, shall meet the requirements of ASTM D 4956, Type II or Type III except that temporary advanced warning construction signs used on interstate highways shall meet the requirements of ASTM D 4956, Type III.

Reflective sheeting for vertical panels shall meet the requirements of ASTM D 4956, Type III. Reflective sheeting for drums shall be a minimum of 6 inches (150 mm) wide and shall meet the requirements of ASTM D 4956, Type III, and the Supplementary Requirement S2 for Reboundable Sheeting with the following modifications pertaining to artificial weathering. The reboundable reflective sheeting shall be tested for accelerated outdoor exposure at an angle of 45 degrees from the horizontal and facing south for 12 months in accordance with ASTM G7 Reflective sheeting for traffic cone collars shall meet the requirements of ASTM D 4956, Type VI.

(g) Sheeting Guaranty. The contractor shall provide the City with a guaranty from the sheeting manufacturer stating that if the retroreflective sheeting fails to comply with the performance requirements of this subsection, the sheeting manufacturer shall do the following:

**Table 215-6
Manufacturer's Guaranty-Reflective Sheeting**

Type	Manufacturer shall restore the sign face in its field location to its original effectiveness at no cost to the City if failure occurs during the time period ¹ as specified below		Manufacturer shall replace the sheeting required to restore the sign face to its original effectiveness at no cost to the City if failure occurs during the time period ¹ as specified below
	Orange	All colors, except orange	All colors, except orange
I	Not used	<5 years	5-7 years
II	<3 years	<5 years	5-10 years
III	<3 years	<7 years	7-10 years
DOTD Type VII	<3 years	<5 years	Not used
DOTD Type VIII	Not used	<5 years	5-10 years

¹ From the date of sign installation.

(1) Replacement sheeting for sign faces, material, and labor shall carry the unexpired guaranty of the sheeting for which it replaces.

(2) The sign fabricator shall be responsible for dating all signs with the month and year of fabrication at the time of sign fabrication. This date shall constitute the start of the guaranty obligation period.

215.06 NONREFLECTIVE SHEETING.

(a) General Requirements: Nonreflective sheeting film shall consist of an extensible, pigmented, weather-resistant plastic film. Face side of film shall be supported and protected by a paper liner which is readily removable after application without the necessity of soaking in water or other solvents. Colors shall be matched visually and be within the limits shown in Table 10 of ASTM D 4956.

(b) Adhesive Requirements: Sheeting shall have a precoated pressure-sensitive adhesive backing or a tack-free heat-activated adhesive backing, either of which may be applied without additional coats on either sheeting or application surface. Adhesive shall comply with ASTM D 4956, Class 1 (pressure sensitive) or Class 2 (heat activated).

(c) Physical Characteristics: The film shall be readily cut by normal fabricating methods without cracking, checking or flaking. Applied film shall be free from ragged edges, cracks and blisters. The material shall have demonstrated its ability to withstand normal weathering without checking, cracking or excessive color loss.

215.07 SIGN ENAMELS, PAINTS, SILK SCREEN PASTE AND OVERLAY FILM.

(a) Sign Enamels and Paints: These shall be applied in accordance with the sheeting manufacturer's recommendations. Final appearance as well as materials used shall be subject to approval.

(b) Silk Screen Paste: Constituents used in manufacture of silk screen paste shall meet approval of the engineer. Silk screen paste shall be mixed at the factory, well ground to a uniform consistency and smooth texture, and shall be free from water and other foreign matter. It shall dry within 18 hours to a film that does not run, streak, or sag. Paste which has livered, hardened or thickened in the container, or in which pigment has settled out so that it cannot be readily broken up with a paddle to a uniform usable consistency, will be rejected. Paste and thinner shall be used in accordance with the sheeting manufacturer's recommendations. Paste shall have proper pigmentation and consistency for use in silk screen equipment. The material shall produce the desired color and the same retroreflectivity values as required for reflective sheeting of the same type and color when applied on reflective sheeting background. Paste shall meet the quality and test requirements for appearance, coarse particles, and moisture and water resistance as specified for sign paints.

(c) Overlay Film: Transparent electronic cuttable overlay film shall produce the desired color and the same reflectivity values as required for reflective sheeting of the same type and color when applied on reflective sheeting background. The film shall be an approved product listed in QPL 13.

215.08 TEMPORARY PAVEMENT MARKINGS.

(a) Temporary Tape: Temporary tape shall comply with ASTM D 4592, Type I (removable) or Type II (non-removable) and shall be an approved product listed in QPL-60.

(b) Painted Stripe: Paint shall be an approved traffic paint complying with Subsection 215.12. Glass beads for drop-on application shall comply with Subsection 215.13.

(c) Temporary Raised Pavement Markings for Asphaltic Surface Treatment: Temporary raised pavement markers for asphaltic surface treatment shall be flexible reflective tabs having a nominal width of 4 inches (10 cm). The markers shall be yellow with amber reflective area on both sides. The body of the marker shall consist of a base and vertical wall made of polyurethane or other approved material and shall be capable of maintaining a reasonable vertical position after installation. The initial minimum reflectivity at an entrance angle of -4 degrees and an observation angle of 0.2 degrees shall be 230 mcd/lx when measured in accordance with ASTM E 810.

The reflective material shall be protected with an easily removable cover of heat resistant material capable of withstanding and protecting the reflective material from the application of asphalt at temperatures exceeding 325°F (160°C). The markers shall be an approved product listed in QPL 74.

215.09 RAISED PAVEMENT MARKERS. Markers shall be either nonreflectorized or reflectorized, as specified. Markers shall be approved products listed in QPL 9. Infrared curves of materials used in markers shall match approved curves on file at the City's Traffic Engineer's Office.

(a) Nonreflectorized Markers:

(1) Description: Nonreflectorized markers shall consist of an acrylonitrile-butadiene-styrene polymer or other approved material, and shall be 4-by-6-inches (100-by-150-mm).

(2) Physical Requirements: Markers shall comply with ASTM D 4280. The color shall be in accordance with the plans and the MUTCD.

(b) Reflectorized Markers: Reflectorized markers shall comply with ASTM D4280, Designation H - Marker with hard, abrasion-resistant lens surface. The type and color shall be in accordance with the plans and the MUTCD. The markers shall be either standard having approximate base dimensions of 4-by-4-inches (100-by-100-mm) and a maximum height of 0.80 inches (20 mm) or low profile having approximate base dimensions of 4-by-2-inches (100-by-50-mm) and a maximum height of 0.60 inches (15 mm).

(c) Adhesive:

(1) Epoxy Adhesive: Epoxy adhesive shall be Type V epoxy resin system complying with Subsection 1017.02.

(2) Bituminous Adhesive: The adhesive shall conform to ASTM D 4280 and shall be an approved product listed in QPL 59.

215.10 THERMOPLASTIC PAVEMENT MARKINGS.

(a) Description: This specification covers hot-sprayed or hot-extruded reflective thermoplastic compound for pavement markings on asphaltic or portland cement concrete pavement. Thermoplastic marking material applied to asphaltic surfaces shall consist of an alkyd based formulation. Thermoplastic marking material applied to portland cement concrete surfaces shall consist of either an alkyd based or hydrocarbon based formulation. Material shall be so manufactured as to be applied by spray or extrusion to pavement in molten form, with internal and surface application of glass spheres, and upon cooling to normal pavement temperature, shall produce an adherent, reflectorized pavement marking of specified thickness and width, capable of resisting deformation.

Material shall not scorch, break down, or deteriorate when held at the plastic temperature specified in DOTD Subsection 732.03(d)(1) for four hours or when reheated four times to the plastic temperature. Temperature-vs-viscosity characteristics of plastic material shall remain constant when reheated four times, and shall be the same from batch to batch. There shall be no obvious change in color of material as the result of reheating four times or from batch to batch.

(b) Suitability for Application: Thermoplastic material shall be a product especially compounded for pavement markings. Markings shall maintain their original dimension and placement and shall not smear or spread under normal traffic at temperatures below 140°F (60°C). Markings shall have a uniform cross section. Pigment shall be evenly dispersed throughout its thickness. The exposed surface shall be free from tack and shall not be slippery when wet. Material shall not lift from pavement in freezing weather. Cold ductility of material shall be such as to permit normal movement with the pavement surfaced without chipping or cracking.

(c) Standard Thermoplastic Pavement Markings: Materials shall be approved products listed in QPL 63 and shall comply with AASHTO M 249 and the specifications as stated herein with the following modifications:

(1) Color: The yellow thermoplastic shall comply with the requirements of Table 215-7 following table when tested in accordance with ASTM E 1349.

**Table 215-7
Color Specification Limits (Daytime)**

Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Yellow	0.4756	0.4517	0.4985	0.4779	0.5222	0.4542	0.4919	0.4354

(The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with Standard Illuminant C.)

(2) Whiteness Index: The white thermoplastic shall have a minimum whiteness index of 40 when tested according to ASTM E 313.

(d) Inverted Profile Thermoplastic Pavement Markings: Materials shall be approved products listed in QPL 63 and shall comply with AASHTO M 249 and these specifications as follows:

(1) Bead Content: Glass bead content for inverted profile thermoplastic pavement markings shall be in accordance with Table 215-8.

**Table 215-8
Bead Content**

U.S. Standard Sieve Size (Microns)	Class A ¹ -- 10% min. (by wt.) of thermoplastic compound, Percent Retained	Class B ¹ -- 25% min. (by wt.) of thermoplastic compound
14 (1400)	0-1	Beads shall meet gradation requirement of AASHTO M247, Type I. I
16 (1190)	0-20	
18 (1000)	0-45	
20 (840)	30-80	
30 (595)	20-50	
Pan	0-10	

¹ Refer to Section 732 when applying as drop-on beads for inverted profile thermoplastic pavement markings.

(2) Bead Quality: The glass beads shall be coated with A-116 Silane or other adhesion promoting coating. The glass beads shall have a maximum of 3 percent irregular particles and a maximum of 5 percent air inclusions. The percentage of true spheres shall be 90 percent minimum for Class A beads and 80 percent minimum for Class B beads.

(3) Binder Content: The binder content of the thermoplastic material shall be 19 percent minimum.

(4) Titanium Dioxide: The titanium dioxide shall meet ASTM D476, Type II, Rutile grade - 93 percent minimum titanium content.

(5) Yellow Pigment: The yellow pigment for the yellow thermoplastic material shall be 4 percent minimum.

(6) Color: The yellow thermoplastic shall comply with the requirements of the Table 215-9 when tested in accordance with ASTM E 1349.

**Table 215-9
Color Specification Limits (Daytime)**

Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Yellow	0.4756	0.4517	0.4985	0.4779	0.5222	0.4542	0.4919	0.4354

(The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with Standard Illuminant C.)

(7) Whiteness Index: The white thermoplastic shall have a minimum whiteness index of 40 when tested according to ASTM E 313.

(8) Specific Gravity: The specific gravity of the thermoplastic pavement marking material shall not exceed 2.35.

(9) Flowability: After heating the thermoplastic material for four (4) hours $\pm$ 5 minutes at $425 \pm 3^\circ\text{F}$ ($218 \pm 2^\circ\text{C}$) and testing flowability, the white thermoplastic shall have a maximum percent residue of 22 percent and the yellow thermoplastic shall have a maximum residue of 24 percent.

(10) Reflectivity: The initial reflectance for the in-place marking shall have the minimum reflectance value of 450 mcd/lux/sq m for white and 350 mcd/lux/sq m for yellow when measured with a geometry of 1.5 degrees observation angle and 86.5 degrees entrance angle.

(11) Wet Reflectivity: The minimum in-place marking when wet shall have the minimum reflectance value of 200 mcd/lux/sq m for white and 175 mcd/lux/sq m for yellow when measured with a geometry of 1.5 degrees observation angle and 86.5 degrees entrance angle. The stripe shall be wet utilizing a pump type garden sprayer for 30 seconds. After 5 seconds, place the reflectometer on the stripe and measure the retro reflectance.

(12) Retained Reflectivity: The thermoplastic pavement marking material shall retain the minimum reflectance value of 130 mcd/lux/sq m for at least four years after placement. Failure to meet this requirement shall require the contractor to replace the portion of the material shown to be below these minimums. The contractor shall provide a written warranty indicating the terms of this requirement.

(13) Inverted Profile: The thermoplastic pavement marking material shall be applied to have a individual profiles having a minimum height of 0.140 inches (3.5 mm) with the recessed inverted profiles having a thickness of 0.025 to 0.050 inches (0.6 mm to 1.25 mm). The profiles shall be well defined and not excessively run back together.

215.11 PREFORMED PLASTIC PAVEMENT MARKING TAPE:

(a) General: Preformed plastic pavement marking tape shall be approved products listed on QPL 64 and shall comply with ASTM D4505 Type I, Type I - High Performance (as specified below) or Type V, except as modified herein. The marking tape shall be Grade A, B, C, D, or E. The type and color shall be in accordance with the plans and the MUTCD.

(b) Thickness: All preformed plastic pavement marking tape shall have a minimum overall thickness of 0.060 inches (1.5 mm) when tested without the adhesive.

(c) Friction Resistance: The surface of the Type I preformed plastic pavement marking tape shall provide a minimum frictional resistance value of 35 British Polish Number (BPN) when tested according to ASTM E303. The surface of the Type I - High Performance and Type V preformed plastic pavement marking tape shall provide a minimum frictional resistance value of 45 BPN when tested according to ASTM E303 except values for the Type V are calculated by averaging values taken at downweb and at a 45 degrees angle from downweb.

(d) Retroreflective Requirements: The preformed plastic pavement marking tape shall have the minimum specific luminance values shown in Table 215-10 when measured in accordance with ASTM D 4061.

**Table 215-10
Specific Luminance**

<u>Type</u>	<u>Observation Angle, degrees</u>	<u>Entrance Angle, degrees</u>	<u>Specific Luminance (mcd/sq m/lx)</u>	
			<u>White</u>	<u>Yellow</u>
I	0.2	86	500	400
	1.0	86.5	300	175
I- High Performance	0.2	86	700	560
	1.0	86.5	400	225
V	0.2	86	1100	800
	1.0	86.5	700	500

(e) Durability Requirements: The Type I - High Performance preformed plastic pavement marking tape shall show no appreciable fading, lifting or shrinkage for a least 12 months after placement when placed in accordance with the manufacturer's recommended procedures on pavement surfaces having a daily traffic count not to exceed 15,000 ADT per lane. The Type V preformed plastic pavement marking tape shall show no appreciable fading, lifting or shrinkage for a least 4 years after placement for longitudinal lines and at least 2 years after placement for symbols and legends.

The Type V preformed plastic pavement marking tape shall also retain the following reflectance values for at least 4 years after placement for longitudinal lines and at least 2 years after placement for symbols and legends:

<u>Observation Angle, degrees</u>	<u>Entrance Angle, degrees</u>	<u>Specific Luminance (mcd/sq m/lx)</u>	
		<u>White</u>	<u>Yellow</u>
1.0	86.5	100	100

(f) Plastic Pavement Marking Tape Guaranty (Type I - High Performance and Type V): If the plastic pavement marking tape fails to comply with the performance and durability requirements of this subsection within 12 months for Type I - High Performance and 4 years for Type V, the manufacturer shall replace the plastic pavement marking material at no cost to the City.

215.12 TRAFFIC PAINT. The contractor shall have the option of furnishing either aklyd traffic paint or water-borne traffic paint; however, the same type paint shall be used throughout the project. Each paint container shall bear a label with the name and address of manufacturer, trade name or trademark, type of paint, number of gallons, batch number and date of manufacture. Paints shall be approved products listed in QPL 36, shall show no excessive

settling, caking or increase in viscosity during 6 months of storage, and shall be readily stirred to a suitable consistency for standard spray gun application. An infrared curve shall be generated in accordance with DOTD TR 610 and compared with the standard curve made during the initial qualification process.

(a) Alkyd Traffic Paint: This material shall be a rapid-setting compound suitable for use with hot application equipment. The material shall meet the requirements of Table 215-11.

Table 215-11
Alkyd Traffic Paint Physical Properties

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>	
		<u>Min.</u>	<u>Max.</u>
Weight, kg/L	ASTM D 1475	1.5	---
Viscosity @ 25°C, Krebs Units	ASTM D 562	85	115
Dry to No Pick Up, s	ASTM D 711	---	180
Directional Reflectance, %	ASTM E 97		
White		80	---
Yellow		50	---
Bleeding	Fed. Spec. TT-P-115	Pass	
Total Solids, % by mass	ASTM D 1644, Method A	70	---
Film Shrinkage	¹	Pass	
Hiding Power		Pass	
Pigment, %	ASTM D 2371	50	55
Nonvolatiles in Vehicle, % by mass	ASTM D 215	35	---
Flexibility	Fed. Spec. TT-P-1952	Pass	
Pigment Composition	³	Pass	

¹ Film Shrinkage: With a film applicator, cast a wet film with a thickness of 30 mils (750 µm) over a smooth glass plate. Allow sample to cure at room condition for 4 to 5 hours. Using a micrometer, measure the plate thickness before the film is cast using five measurements to obtain an average. The cured film shall have a minimum thickness of 12 mils (300 µm).

² Hiding Power: The paint shall have a wet hiding power of at least 350 square feet per gallon (8.6 m²/L). The compound shall have sufficient hiding power to cover any pavement when applied at a wet film thickness of 15 mils (375 µm).

³ Pigment Composition: White paint shall contain at least 1.5 pounds (180 g) of titanium dioxide (TiO₂) pigment per gallon as determined using DOTD TR 523 with at least 92 percent TiO₂ content. The TiO₂ shall comply with ASTM D 476. Yellow paint shall contain at least 1.3 pounds (160 g) of medium chrome yellow pigment per gallon (L) as

determined using DOTD TR 523. Medium chrome yellow pigment shall comply with ASTM D 211, Type III.

(b) Water Borne Traffic Paint: This material shall be a rapid setting waterborne compound suitable for use with hot application equipment. The material shall meet the requirements of Table 215-12.

Table 215-12
Water Borne Traffic Paint Physical Properties

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>	
		<u>Min.</u>	<u>Max.</u>
Weight, kg/L	ASTM D 1475	1.5	---
Viscosity @ 25°C, Krebs Units	ASTM D 562	75	90
Dry to No Pick Up, s	ASTM D 711	---	10
Dry through, min.	ASTM D 1640	---	20
Volume Solids, %	---	58	---
Total Solids, % by mass	ASTM D 2369	70	---
Pigment, % by mass	ASTM D 3723	45	55
Nonvolatile Vehicle, % by mass	Fed. Test 141B	40	---
Bleed Ratio	Fed. Spec. TT-P-1952	0.96	---
Daylight Reflectance, %	Fed. Test 141B		
White		85	---
Yellow		54	---
Hiding Power (Contrast Ratio) at 250 µm	Fed. Test 141B	0.96	---
Flexibility	Fed. Spec. TT-P-1952		Pass
Drying Time, min.	¹	---	3
Fineness of Grind	ASTM D 1210	3	---
Freeze-Thaw	ASTM D 2243		Pass
Heat Stability	Fed. Spec. TT-P-1952		Pass
Color	²		Pass
Volatile Organic Compounds (g/L)		---	150

¹ Drying time to no track - Paint applied at 15 mils (375 μm) wet on the road surface with paint heated to 120-150°F (50-65°C) shall not show tracking when a standard size automobile crosses in a passing maneuver at 3 minutes.

² Color - Yellow paint shall comply with the requirements of Table 215-13 when tested in accordance with ASTM E 1349. White shall be a clean, bright, untinted binder.

³ The white paint shall contain a minimum of 1.0 pound per gallon (120 g/L) of titanium dioxide (TiO₂) as determined using DOTD TR 523. The titanium dioxide shall comply with ASTM D 476.

Table 215-13
Water Borne Traffic Paint Color Specification Limits (Daytime)

Color	1		2		3		4	
	x	y	x	y	x	y	x	y
Yellow	0.4756	0.4517	0.4985	0.4779	0.5222	0.4542	0.4919	0.4354

(The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 Standard Colorimetric System measured with Standard Illuminant C.)

215.13 GLASS BEADS FOR DROP-ON APPLICATION: Glass beads shall comply with AASHTO Designation M247, Type I, with the following modifications shown in Table 215-14. Glass beads shall be coated with an adhesive promoting coating which shall also provide moisture resistance.

Table 215-14
Gradation of Glass Beads for Drop-On Application

Sieve Designation Standard, mm	Percent Passing
1.180	99-100
0.850	75-95
0.600	55-85
0.425	---
0.300	10-35
0.180	---
0.150	0-5

PART 3

EARTHWORK

SECTION 301

CLEARING AND GRUBBING

301.1 GENERAL. Clearing and grubbing shall consist of removing all natural and artificial objectionable materials from the right-of-way in construction areas, road approaches, material sites within the right-of-way, areas through which ditches and channels are to be excavated, and such other areas as may be specified on the Drawings. This work shall be performed in advance of grading operations and in accordance with the requirements herein specified, subject to erosion control requirements. Demolition of buildings and structures, other than foundations or slabs, shall be as specified on the plans.

The natural ground surface shall be cleared of all vegetable growth, such as trees, logs, upturned stumps, roots of downed trees, brush, grass, weeds, and all other objectionable materials within the limits of construction.

Grubbing shall extend to the outside excavation and fill slope lines, except that where slopes are to be rounded, the area shall extend to the outside limits of slope rounding. Within the limits of clearing, all stumps, roots 1½ inches (38 mm) in diameter or larger, buried logs, and all other objectionable material shall be removed 3 feet (0.9 m) below the existing ground surface or subgrade, whichever is deeper. No payment will be made to the contractor for clearing and grubbing outside the stated limits, unless such work is authorized by the Engineer.

Trees and plants that are not to be removed shall be fully protected from injury by the contractor at its expense. Trees shall be removed in such a manner as not to injure standing trees, plants, and improvements which are to be preserved.

301.2 PRESERVATION OF PROPERTY. Existing improvements, adjacent property, utility and other facilities, and trees and plants that are not to be removed shall be protected from injury or damage.

301.3 REMOVAL AND DISPOSAL OF MATERIALS. All materials removed shall be disposed of outside of the right-of-way, unless burning is permitted. Burning shall be done only if permitted by local regulations and at such times and in such manner as to prevent the fire from spreading to areas adjoining operations, the piles may be placed in the most convenient location at the side of the right-of-way and beyond slope lines where they may be burned without damage to the surrounding area. No accumulation of flammable material shall remain on or adjacent to the right-of-way. The roadway and adjacent areas shall be left with a neat and finished appearance.

301.4 PAYMENT. The lump sum price, or the price per acre, bid for clearing and grubbing shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in clearing and grubbing as shown on the plans, and as specified in these specifications, and as directed by the Engineer, including the removal and disposal of all the resulting materials. When the contract does not include a pay item for clearing and grubbing as above specified, full compensation for any necessary clearing and grubbing required to perform the construction operations specified shall be considered as included in the price bid for other items of work and no additional compensation will be allowed therefore. Partial payment will be limited to 10 percent of the original total

contract until the contractor has earned 40 percent of the original contract amount. Payment will be made under:

Item No.	Pay Item	Pay Unit
301 (1)	Clearing and Grubbing	Lump Sum
301 (2)	Clearing and Grubbing	Per Acre

SECTION 302

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

302.1 DESCRIPTION. This work shall consist of the removal and satisfactory disposal of all buildings, fences, structures, old pavements, abandoned pipe line, and any other obstructions which are not designated or permitted to remain. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits. When the proposal does not include pay items for removal of structures and obstructions, as set out in this section, cost of such work shall be included in prices bid on other construction items.

302.2 CONSTRUCTION REQUIREMENTS. The Contractor shall remove and dispose of all buildings and foundations, structures, fences and other obstructions, any portions of which are on the right-of-way, except utilities and those for which other provisions have been made for removal. All designated salvageable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported and shall be stacked at specified storage areas by the Contractor within the project limits or hauled to a designated maintenance storage yard and stacked. All materials designated not to be salvaged may be destroyed or disposed of off the project outside the limits of view with written permission of the property owner on whose property material is placed. Copies of all agreements with property owners are to be furnished to the Engineer. Basements or cavities left by structure removal shall be filled to the level of the surrounding ground and, if within the prism of construction, shall be compacted to the approximate density of the surrounding ground.

302.3 REMOVAL OF BRIDGES, CULVERTS AND OTHER DRAINAGE STRUCTURES.

Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic. Unless otherwise directed, the substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down one foot (.3 m) below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Steel bridges and wood bridges as specified, shall be carefully dismantled without unnecessary damage. This dismantling shall include the stripping of all hardware and the removal of all nails. Steel members shall be match marked before dismantling unless otherwise indicated. All salvaged material shall be stored or removed as specified in Subsection 302.2. Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work.

302.4 REMOVAL OF PIPE. Unless otherwise provided, all pipe to be salvaged shall be carefully removed and every precaution taken to avoid breaking or damaging the pipe. Pipes to be relaid shall be removed and stored so that there will be no loss or damage before relaying. The contractor shall replace sections lost from storage or damaged by negligence or by use of improper methods. Pipes not to be relaid and considered usable shall be salvaged, cleaned of soils or other materials, stored or removed and stacked as specified in Subsection 302.2.

302.5 REMOVAL OF PAVEMENTS, SIDEWALKS, CURBS, ETC. Unless otherwise specified, all concrete pavements, base course, sidewalks, curbs, gutters, etc., designated for removal, shall be disposed of outside the right-of-way and beyond the limits of view of the traveling public in accordance with Subsection 302.2. When specified, ballast, gravel, bituminous material or other surfacing or pavement materials shall be removed and stockpiled as required in Subsection 302.2; otherwise, such materials shall be disposed of as directed by the Engineer.

302.6 ROCK EXCAVATION. Rock excavation shall include blasting, excavating grading, and disposing of material classified as rock and shall include the satisfactory removal and disposition of boulders 1/2 cubic yards (.38 cu. m) or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling and blasting; and conglomerate deposits that are so firmly cemented as to possess the characteristics of solid rock that is impossible to remove without systematic drilling and blasting.

The removal of any concrete structures or pavements, that may be encountered in the work shall not be included in this classification. If at any time during excavation, including excavation from borrow areas, the contractor encounters material that may be classified as rock excavation, such material shall be uncovered and the Engineer notified by the contractor. The contractor shall not proceed with the excavation of this material until the Engineer has classified the materials as rock excavation and has taken cross sections as required. Failure on the part of the contractor to uncover such material, notify the Engineer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Engineer for the areas of work in which such deposits occur.

302.7 METHOD OF MEASUREMENT. When the contract stipulates that payment will be made for removal of obstructions on a lump sum basis, the pay items, "Removal of Obstructions", will include all structures and obstructions encountered within the right-of-way in accordance with the provisions as set out in this section. Where the proposal stipulates that payment will be made for the removal of specified items on a unit basis, measurement will be made by the unit stipulated in the contract.

302.8 BASIS OF PAYMENT. The accepted quantities of removal of structures and obstructions will be paid for at the contract lump sum price bid, which price shall be full compensation for removing and disposing of the obstructions in accordance with the contract. Unless specifically provided for there shall be no direct payment for the removal of pipe. Specific obstruction items, stipulated for removal or disposal under unit price pay items will be paid for at the contract unit price bid per unit specified in the proposal, which price shall be full compensation for removal and disposal of such items, excavation and subsequent backfill incidental to their removal. The price shall also include salvage of materials removed, their custody, preservation, storage on the right-of-way and disposal as provided herein.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
302(1)	Removal of Structures & Obstruction	Per Lump Sum
302(2)	Removal of Bridges	Per Each
302(3)	Removal of Reinforced Concrete Structures	Per Each
302(4)	Removal of Steel Structures	Per Each
302(5)	Removal of Building Structures	Per Each
302(6)	Removal of Concrete Pavement	Per Square Yard
302(7)	Removal of Pavement Base & Surface	Per Square Yard
302(8)	Removal of Concrete Walks & Driveways	Per Square Yard
302(9)	Removal of Concrete Curb & Gutter	Per Linear Foot
302(10)	Removal of Concrete Curb	Per Linear Foot
302(11)	Rock Excavation	Per Cubic Yard

SECTION 303

ROADWAY EXCAVATION

303.1 DESCRIPTION. Roadway excavation shall consist of excavation involved in the grading and construction of roadways, except structural excavation, separately designated. It shall include excavating, removing, hauling, placing, compacting, and satisfactorily disposing of all materials encountered in the excavation for the roadway, ditches, channel changes and all operations necessary for the roadway excavation in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer. Rock encountered in roadway excavation shall be defined, removed and paid for as provided in Subsection 302.6.

303.2 CLEARING AND GRUBBING. Prior to beginning excavation, grading, and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 301, Clearing and Grubbing.

303.3 SLOPES. Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. Debris and loose material shall be removed. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated plane by more than six inches (15.3 cm), measured at the right angles to the slope.

Tops of excavation slopes and ends of excavations shall be rounded as shown on the plans and these quantities shall not be included in the quantities of excavation to be paid for. This work will be considered as a part of finishing slopes and no additional compensation will be allowed therefore. Embankment slopes shall be finished in conformance with lines and grades shown on the plans. When completed, the average plane of embankment slopes shall conform to slopes indicated on the plans and no point on completed slopes shall vary from the designated plane by more than six inches (15.3 cm) measured at right angles to the slope. The placing and compacting of embankments shall conform to the applicable portions of Section 304.

303.4 SURPLUS MATERIAL. Unless otherwise shown on the drawings, or approved by the Engineer, no surplus excavated material shall be disposed of within the right-of-way. The Contractor shall make all arrangements for disposal of the material at off-site locations as may be approved by the owner of adjacent property, and shall upon request, file with the Engineer the written consent of the owner of the property upon which he intends to dispose of such material. Consideration shall be given to the abutting property owner, should he request the surplus material be placed on the abutting property.

303.5 UNSTABLE AND UNSUITABLE MATERIAL. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Material outside the planned roadway or ditch slopes which is unstable and constitutes potential slides in the opinion of the Engineer, material which has come into the roadway channel or ditch, and material which has slipped out of new or old embankments shall be excavated and removed. The material shall be excavated to designated lines or slopes either by benching or in such manner as directed by the Engineer. Such material shall be used in the construction of the embankments or disposed of as directed by the Engineer. Only those quantities of slide or slipout material which are actually removed as ordered by the Engineer will be paid for.

The above provisions shall not be so construed as to relieve the Contractor from his obligation to maintain all slopes true and smooth. The Contractor shall conduct his operations in such a way that the Engineer can take the necessary cross-sectional measurements before the backfill is placed. Where excavation to the finished graded section results in a subgrade or slopes of unsuitable or unstable soil, the Engineer may require the Contractor to remove the unsuitable or unstable materials by undercutting and backfill to the finished graded section with approved material.

Material shall be considered unsuitable for fill, subgrade, shoulders and other uses if it contains organic matter, soft spongy earth, or other matter of such nature that compaction to the specified density is unobtainable. The removal and disposal of such unsuitable material will be paid for as Roadway Excavation for the quantities involved, whether or not the removal of such material is shown on the Drawings.

303.6 METHOD OF MEASUREMENT. Measurement will be made by either of the following methods or as designated on Drawings.

(a) Contract Quantity Payment. The quantities of excavation for which payment will be made will be those shown in the contract for the various items, provided the project is constructed essentially to the lines and grades shown on the plans. When the plans have been altered or when disagreement exists between the Contractor and the Engineer, as to the accuracy of the plan quantities in any balance, or the entire project, either party shall have the right to request and cause the quantities involved to be measured in accordance with measured quantities. When the quantities are measured for payment, the original plan cross sections plotted on the plans shall be used as original field cross sections. Additional original cross sections may be interpolated at points where necessary to more accurately determine the quantities.

(b) Measured Quantities. When payment is specified on a volume basis, all accepted excavation shall be measured in its original position by cross-sectioning the area excavated, which measurements will include slides in unclassified material not attributable to carelessness of the Contractor. Volumes will be computed from the cross-section measurements by the average end area method. Measurements will be made for unsuitable materials actually excavated and removed to obtain proper compaction in cut sections and in foundations for fill sections.

No measurement will be made of the suitable material temporarily removed and replaced to facilitate compaction of the material for the full depth shown on the plans. Where it is impractical to measure material by the cross-section method due to the erratic location of isolated deposits, acceptable methods involving three-dimensional measurements may be used.

(c) Vehicular Measurement. When specified in the project specifications or authorized by the Engineer, excavated material may be measured by the cubic yard in approved hauling vehicles at the point of delivery.

303.7 BASIS OF PAYMENT. The accepted quantities of roadway excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping, rounding tops and ends of excavations, loading, depositing, conditioning, spreading, and compacting the material complete in place and disposal of surplus material.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
303 (1)	Roadway Excavation	Per Cubic Yard
303 (2)	Roadway Excavation (Vehicular Measurement)	Per Cubic Yard
303(3)	Excavation & Embankment	Lump Sum

SECTION 304

FILL CONSTRUCTION

304.1 DESCRIPTION. Fill construction shall consist of constructing embankments except as may otherwise be specified, including the preparation of the areas upon which they are to be placed; the construction of dikes; areas as shown on the plans and where unsuitable material has been removed; and the placing and compacting of material in holes, pits, and other depressions as directed by the Engineer.

304.2 PLACING. Rocks, broken concrete, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven. When embankments are constructed on a hillside sloping more than 6:1 from the horizontal, the slope of the ground on which the embankment is to be placed shall be plowed or cut into steps before the fill is placed. Material thus cut out shall be recompacted along with the new embankment material at the contractor's expense. Where a new road is to be constructed on an old road, the old road shall be plowed or scarified and broken up full width to a depth of not less than 6 inches (15.24 cm), regardless of height of new fill, and recompacted as directed. Unless shown otherwise by the plans or special provisions, heavy sod and objectionable vegetable matter shall be completely removed to a minimum depth of approximately 6 inches (15.24 cm). This area shall then be compacted to a relative compaction of not less than 90%, as determined by Method A or AASHTO Designation T 99 (Standard).

Roadway embankment of earth material shall be placed in layers or lifts approximately parallel to the finished grade line not exceeding approximately 8 inches (20.32 cm) (loose measurement). Each lift shall be placed for the full width of the embankment and compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain reasonably uniform thickness prior to compacting. As the compaction of each layer progresses, necessary spreading and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density.

304.3 COMPACTING. Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified with the following exception. Embankments constructed of rock fills, sand fills placed in water and in the first layer of fills constructed through or into lakes, streams, swamps and other soft areas shall be constructed and compacted in such a manner as to permit construction of superimposed layers as specified. These materials shall be placed in accordance with Subsection 304.2.

In cut areas, for the full width of roadbed in all cut sections, the top 6 inch (15.3 cm) layer on which fill or base material is to be placed, shall be thoroughly scarified and the moisture content increased or reduced as necessary. This 6 inch (15.3 cm) layer shall then be compacted to not less than 95% of the maximum density. When required by the plans, the top of the embankment in both cut and fill sections shall be constructed of selected material and compacted to not less than 95% of maximum density.

All material in embankments requiring density control, as per the load zone drawing, shall be placed in layers not to exceed 8 inches (20.32 cm) in thickness, and shall be compacted to not less than 95% of maximum density. At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill will be firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no

additional compensation will be allowed therefore.

Compaction of embankments may be accomplished by any satisfactory method or methods that will obtain the required density unless a specific method is required by the special provisions. Dumping and rolling areas shall be kept separate and no lift shall be covered by another until density complying with the requirements of this subsection is secured. Relative compaction shall be determined by Method A of AASHTO Designation T 180.

304.4 BASIS OF PAYMENT. Fill construction as defined in this Section is a method of construction the payment for which shall be included in Roadway Excavation, Borrow Excavation, Channel Excavation or Structural Excavation.

SECTION 305

BORROW EXCAVATION

305.1 DESCRIPTION. This work shall consist of excavating from borrow pits, transporting material to the proper site, placing and compacting of material for the construction of fills in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer.

305.2 MATERIAL. The material for Borrow Excavation shall be tested and classified by the laboratory before being placed in embankments and, subject to the restrictions for suitable material hereinafter contained, shall be American Association of State Highway Officials Soil Identification Classes (AASHTO Designation: M 145) A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-3, A-4, A-5, A-6, except that material in the A-5, A-6, classes considered unsatisfactory by the Engineer will not be accepted, and should a material of the A-3 class (sand) be used, the contractor will be required to use on slopes a material of the A-4, A-5, and/or A-6 Classification. Should a material of the A-1-b class (coarse sand or gravelly sand) be used, the contractor will be required to use on slopes a material of the A-4, A-5, A-6, A-7-5, and/or A-7-6 classification at the discretion of the Engineer.

305.3 LOCAL BORROW. Local borrow shall consist of material excavated and used in the construction of fills or for use as selected material or for other construction purposes. Local borrow shall be material which is excavated from sources shown on the drawings, or designated by the Engineer. The contractor will have no choice or selection of the source of material to be excavated. Local borrow shall be excavated to the lines and grades established by the Engineer.

305.4 IMPORTED BORROW. Imported borrow shall consist of material required for construction, and unless otherwise designated, the contractor shall make his own arrangements for obtaining imported borrow and he shall pay all costs involved. Imported borrow shall be the best material available from sources indicated on the plans, or approved by the Engineer.

The contractor shall notify the Engineer sufficiently in advance of opening any material sites so that cross-section elevations and measurements of the ground surface after stripping may be taken and sufficient time for testing the material will be allowed. It shall be the responsibility of the contractor to provide all soil test information.

Clearing, grubbing, stripping of pits, and material not used in the embankment will not be measured or paid for. The contractor shall provide and maintain all necessary haul roads from the borrow pits to the work at his own expense.

305.5 PLACING AND COMPACTING. Local borrow and imported borrow shall be placed and compacted as specified in Section 304.

The contractor shall satisfy himself that there is sufficient space available in fill locations for placing any excavated material, before placing imported borrow. Any excess excavation which develops as a result of placing imported borrow in advance of completing excavation shall be disposed of at the contractor's expense in accordance with the provisions in Subsection 303.4 and a corresponding reduction in the quantity of imported borrow to be paid for will be made, for which the contractor will have no claim for compensation.

Borrow pits shall be excavated to regular lines to permit accurate measurement; depth of excavation throughout the areas of borrow pits shall be as uniform as practicable and the side slope shall be dressed to such slope as may be directed, leaving the borrow pit area in a clean and safe condition.

305.6 METHOD OF MEASUREMENT. Quantities of borrow will be measured as specified for Roadway Excavation in Section 303.6.

305.7 BASIS OF PAYMENT. Quantities of borrow excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, sloping, and cleaning of borrow area, hauling, depositing, spreading and compacting the material complete in place, and disposal of surplus material. Material excavated at the borrow site and not used on the work will be deducted from the computed quantities and will not be paid for.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
305 (1)	Local Borrow Excavation	Per Cubic Yard
305 (2)	Imported Borrow Excavation	Per Cubic Yard
305 (3)	Local Borrow Excavation (Vehicle Measurement)	Per Cubic Yard
305 (4)	Imported Borrow Excavation (Vehicle Measurement)	Per Cubic Yard

SECTION 306

MUCK EXCAVATION

306.1 DESCRIPTION. Muck excavation shall consist of the removal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material and satisfactorily disposing of unsuitable materials encountered within the limits of the work. Muck excavation will not include replacement of materials.

306.2 MUCK EXCAVATION. Muck shall include materials which will decay or produce unsatisfactory subsidence in the embankment and may be made up of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment. The Engineer shall determine the material to be classified as muck and wasted as muck and the material that is satisfactory for use in the embankment in accordance with the specifications.

306.3 METHOD OF MEASUREMENT. Quantities of muck excavation will be measured as specified for Roadway Excavation in Section 303.6.

306.4 BASIS OF PAYMENT. Payment for muck will be made under roadway excavation or channel excavation unless otherwise provided.

Quantities of muck excavation will be paid for at the contract unit price per cubic yard. Such price shall include excavating, hauling, and disposal off the job site of the unsuitable material and shall also include the furnishing of all equipment, tools, labor and incidentals and performance of all work necessary to complete the item.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
306 (1)	Muck Excavation	Per Cubic Yard
306 (2)	Muck Excavation (Vehicle Measurement)	Per Cubic Yard

SECTION 307

CHANNEL EXCAVATION

307.1 DESCRIPTION. This work shall consist of excavation and shaping the channel to the lines, grades, and typical sections required for the various type sections of channel improvements proposed, as shown on the plans. It shall further include the hauling, spreading, and disposing of the spoil all in accordance with the requirements of the Drawings.

Earth Channel excavation shall be that required to excavate earth channels. Paved Channel excavation shall be that required in channels which are to receive concrete or other permanent linings.

307.2 EARTH CHANNEL EXCAVATION. The channel shall be cut and dressed in such a manner so that the surfaces of the bank and bottom are left in a reasonably smooth condition. All humps and hollows shall be removed. At no locations shall the cross-section area of the excavated channel be less than that shown on the net cross-section of the plans.

Where the cross-sectional area of the excavated channel is less than that shown by the net cross-sectional lines on the plans, payment will be withheld for the excavation for a distance of two hundred feet (62 m) on each side of the undercut section until such time as the Contractor excavates the undercut sections to the designated cross-sectional area. Material removed to a depth of not more than one foot (.3 m) below the established grade shall be paid for at the full contract price. No payment will be made for any over cutting on the side slopes below the required section.

Where slides occur which in the opinion of the Engineer are no fault of the Contractor, payment will be made as the contract price for earth channel excavation for the removal of all such materials which is in excess of fifteen (15) percent of the net yardage per station at the location of the slide.

The inlets of all ditches or canals entering the new channel shall be shaped so that sharp points of earth, slopes in excess of $1\frac{1}{2}$ to 1, or drops in bottom elevations of inlets to channel shall be corrected in accordance with the directions of the Engineer. No direct payment shall be made for this item of work. The cost thereof shall be included in the price bid for earth channel excavation.

Gaps shall be left in the spoil areas at the locations shown on the plans or as directed by the Engineer. The size of the openings shall be as shown on the plans or as directed by the Engineer. The cost of this work shall be included in the price bid for earth channel excavation.

Spoil. The Contractor shall dispose of the spoil in accordance with the requirements set forth in the plans, inclusive of all requirements in the agreements. However, upon complying with the conditions of the agreements concerning the disposal of the spoil, the Contractor has the option of hauling the balance of the material to spoil areas provided or transporting the material to a location of his choice outside the limits of the project.

307.3 PAVED CHANNEL EXCAVATION. For the concrete revetment sections the Contractor shall do the necessary excavation and filling where required to construct the channel section to the lines and grades set by the Engineer. The surfaces of the bottom and slopes shall be fine graded and placed in a smooth condition in preparation for the construction of the concrete revetments.

On the reaches of the channel where a combination reinforced concrete U-shaped section with paved slopes in constructed, the Contractor shall do the necessary excavating and filling where needed to grade the channel to the typical section required as established by the lines and grades set by the Engineer, and to also cut an additional width to allow working room to place forms for the construction of the vertical reinforced concrete walls. The reinforced concrete walls shall be backfilled with suitable material. Unless otherwise specified, material obtained from the project excavations will be suitable for use as fill or backfill provided that all organic material, rubbish, debris, and other objectionable material contained therein is first removed.

It shall be understood that the removal of stumps or other interfering objects and the backfilling of voids caused by such removals shall be at the expense of the Contractor and no additional payment for the cost of such work will be made. The cost of such work shall be included in the prices bid for the various items of work.

307.4 HANDLING OF WATER. The Contractor shall be responsible for the handling and disposal of all water in the channel. He shall provide for the damming, releasing, pumping, diversion or other disposal as required.

When the work is being done in an operating channel, the Contractor shall be responsible for releasing water during rainstorms and shall exercise care that his operations do not result in any flooding of other property nor any damage from released waters. He shall use due diligence and care so that no water from his work or due to his work or which he is obligated to handle and dispose of under this contract, shall discharge or be discharged on the work of another Contractor unless a mutual agreement of the parties affected is made. Should any disagreement arise from this cause the matter shall be referred to the Engineer for final settlement.

The Contractor may not discharge any water into any sanitary sewer line but may make reasonable use of any ditch, channel, storm drain, or gutter, which is designated and used for City or Parish drainage.

307.5 METHOD OF MEASUREMENT. Earth channel excavation will be measured by the cubic yard and the number of cubic yards shall be determined by measurement in its original position by the method of average end areas. Paved channel excavation will be measured by the number of cubic yards and shall be determined as follows:

- (a) For the revetment section, consisting of paved bottom and slopes, the excavation shall be the number of cubic yards within the section of the channel as established by the grades set by the Engineer. Over cutting of the slopes or bottom will not be considered for pay purposes.
- (b) For the combination section consisting of a U-shaped reinforced concrete structure with paved slopes, the excavation shall be the number of cubic yards in the section established by the grades set by the Engineer plus the number of cubic yards located within an area up to 12 inches (30.5 cm) on either side of the vertical wall. Any over cutting of the sides or bottom will not be considered for pay purposes.
- (c) When specified in the project specifications or authorized by the Engineer, channel excavation may be measured by the cubic yard in approved hauling vehicles at the point of delivery.

307.6 BASIS OF PAYMENT. The number of cubic yards of material excavated measured as provided above shall be paid for at the contract unit price per cubic yard of channel excavation. Price and payment shall constitute full compensation, for the removal of all obstructions as specified herein; filling holes and depressions, backfilling around structures, dressing shoulders and slopes, disposal of all surplus material; damming, pumping, releasing, or otherwise

disposal of water; and shall also include the furnishing of all materials, equipment, tools, labor and incidentals and the performance of all work necessary to complete the item.

When there is no item in the bid quantities for paved channel excavation, the work shall be considered incidental to other items and no direct payment will be made for paved channel excavation.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
307 (1)	Paved Channel Excavation	Per Cubic Yard
307 (2)	Earth Channel Excavation	Per Cubic Yard
307 (3)	Paved Channel Excavation (Vehicle Measurement)	Per Cubic Yard
307 (4)	Earth Channel Excavation (Vehicle Measurement)	Per Cubic Yard

SECTION 308

STRUCTURAL EXCAVATION AND BACKFILL

308.1 DESCRIPTION. Structural excavation shall consist of the removal of material for the construction of foundations for bridges, retaining walls, headwalls for culverts, and other structures, and other excavation designated on the plans or in these specifications as structural excavation.

Structural excavation and backfill shall consist of furnishing material, if necessary, and placing and compacting backfill material around structures to the lines designated on the plans or specified or directed by the Engineer.

Structural excavation and backfill shall include the furnishing of all materials and equipment and the providing of other facilities which may be necessary to perform the excavation and place and compact backfill, and the subsequent removal of facilities, except where they are required or permitted by the plans or by the Engineer to remain in place. It shall also include the wasting or disposal of surplus excavated material in a manner and in locations approved by the Engineer.

308.2 STRUCTURAL EXCAVATION. When footing concrete or masonry is to rest on an excavated surface, care shall be taken not to disturb the bottom of the excavation and final removal of the foundation material to grade shall not be made until just before the concrete or masonry is placed.

When any structural excavation is completed the Contractor shall notify the Engineer who will make an inspection of the excavation. No concrete or masonry shall be placed until the excavation has been approved by the Engineer. The elevation of the bottoms of footings, as shown on the plans, shall be considered as approximate only and the Engineer may order in writing, such changes in dimensions or elevation of footings as may be necessary to secure a satisfactory foundation.

308.3 STRUCTURAL BACKFILL. Backfilling operations shall conform to the following requirements:

Structural backfill shall not be placed until the structure footings or other portions of the structure or facility have been inspected by the Engineer and approved for backfilling. No backfill material shall be deposited against the back of concrete abutments, concrete retaining walls, or the outside walls of cast-in-place concrete culverts until permission shall have been given by the Engineer and until test cylinders show the strength to be twice the working stress used in the design.

If the working stress used in the design is not known, such backfill shall not be deposited until the concrete has developed a strength of not less than the 28 day design compressive strength as determined by test cylinders cured under conditions similar to those prevailing at the site.

Unless otherwise specified, the placement and compaction of structural backfill shall conform to the requirements of Section 304.

Compaction of structural backfill by ponding and jetting will be permitted when, as determined by the Engineer, the backfill material is of such character that it will be self-draining when compacted and that foundation materials will not soften or be otherwise damaged by the applied water and no damage from hydrostatic pressure will result to the

structure. Ponding and jetting of the upper 3 feet (.91 m) below finished subgrade will not be permitted in roadway areas.

When ponding and jetting is permitted, material for use in a structure backfill shall be placed and compacted in layers not exceeding 4 feet (1.22 m) in thickness. The work shall be performed without damage to the structure and embankment, and in such a manner that water will not be impounded.

308.4 PAYMENT. Unless otherwise provided in the Proposal, no payment will be made for structure excavation or backfill as such; the cost thereof under normal circumstances being considered as included in the price bid for the construction or installation of the items to which such excavation or backfill is incidental or appurtenant.

Payment for such excavation or backfill will be made only when the Proposal provides. Unless otherwise shown on the plans, the quantity of the structure excavation, whether paid for as a separate item or not, shall be that volume in place included between a vertical plane 1 foot (305 mm) outside of and parallel with the outermost horizontal dimensions of the structure and between the surface of the existing ground and the footing subgrade.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
308(1)	Structural Excavation	Per Cubic Yard

SECTION 309

RIP-RAP CONSTRUCTION

309.1 DESCRIPTION. This item shall consist of furnishing and placing sacked concrete rip-rap, grouted rubble rip-rap or random rip-rap of the type and depth designated, in accordance with these specifications and in reasonable close conformity with the lines, grades and thicknesses shown on the plans or established by the Engineer. It shall include the furnishing and transportation of materials, the placement, wetting, grouting and curing.

309.2 MATERIALS

309.2.1 Portland Cement. As specified in Subsection 201.1.

309.2.2 Fine Aggregate. As specified in Subsection 200.1.

309.2.3 Coarse Aggregate. As specified in Subsection 200.2.

309.2.4 Rip-Rap Stone. As specified in Subsection 200.7.

309.3 SACKED CONCRETE RIP-RAP. The Portland cement and aggregates shall be thoroughly dry mixed. The aggregate may be pitrun material, at least 80% of which shall pass a 1-1/2 inch (38.1 mm) square mesh screen. Separating aggregates by primary sizes will not be required. Los Angeles abrasion tests and soundness tests will not be required. The mixed concrete shall contain 376 pounds (209 kg) (4 sacks) of Portland cement per cubic yard.

Sacks shall be made of burlap or other open mesh material approved by the Engineer, of 1 or 2 cubic foot (.028 cubic m or .056 cubic m) capacity and uniform size. Sound reclaimed sacks, except those which have been used as containers for sugar or chemicals, may be used. Each sack shall contain approximately the same amount of concrete loosely placed so as to leave room for folding the open ends the fold just enough to retain the concrete at the time the filled sacks are placed. Immediately after filling, the sacks shall be placed and lightly trampled to cause them to conform with the ground surface and with adjacent sacks in place.

Slopes on which the sacked concrete rip-rap is to be placed shall be finished to the designated grades shown on the plans or as directed by the Engineer. The first course shall be a double row of stretchers or headers as shown on the plans or as directed by the Engineer, and shall be placed so that joints between courses are staggered in such a manner as to provide locked construction. Dirt and debris shall be removed from the tops of sacks before the next course is laid thereon. Headers shall be placed with the folds upwards. Sacked rip-rap shall not be less than 8 inches (20.1 cm) in thickness.

309.4 GROUTED RUBBLE RIP-RAP. Stone shall be furnished and placed as specified for random rip-rap and grouted with Portland cement mortar. The amount of water shall be such as to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer. Except when hand mixing is permitted by the Engineer, grout shall be mixed in an approved machine mixer for not less than 1 1/2 minutes. Should hand mixing be permitted, the cement and aggregate shall be thoroughly mixed in a clean, tight mortar box until the mixture is of uniform color after which clean water shall be added in such quantity as to provide a grout of the specified consistency.

309.5 RANDOM RIP-RAP. Rip-rap stone shall be as large as can be conveniently placed in a layer of the required depth. In layers 2 feet (.6 m) or less in depth, the stones, excepting small stones and spalls used to chink interstices shall weigh not less than 50 pounds (24.5 kg) and at least 60% of the stone shall weigh not less than 100 pounds (49 kg). In layers more than 2 feet (.6 m) in depth at least 50% of the mass shall be stones having a volume of 2 cubic feet or more. The bed for the rip-rap shall be shaped and trimmed to provide even surfaces. A footing trench shall be excavated along the toe of the slope as shown on the plans.

When the required rip-rap is less than 20 inches (51 cm) in depth, stone shall be placed by hand. Stone shall be placed to provide a minimum of voids. The larger stone shall be placed in the toe return, foundation course, and on the outer surface of the rip-rap.

The amount of water shall be such as to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer. The amount of water shall be such as to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer.

Stones shall be placed with their longitudinal axis normal to the face of the embankment and so arranged that each rock above the foundation course has at least a 3 point bearing on the underlying stones. Bearing on smaller stones used to chink voids will not be acceptable. Interstices between stones shall be chinked with small stones and spalls. The finished surface shall be even and tight and shall not vary from the planned surface by more than 3 inches per foot (76.2 mm/31 cm) of depth.

When the required rip-rap is 20 inches (51 cm) or more in depth, the stone may be placed by dumping and spread in layers by bulldozers or other suitable equipment. Random rip-rap shall not be less than 12 inches (31 cm) in thickness.

When specified, geotextile fabric shall be place on the prepared slope or area in accordance with Section 404 before placement of rip-rap. Placing rip-rap by rolling rip-rap down the slope or dropping rip-rap from extreme heights or by similar methods likely to damage geotextile fabric, will not be permitted. Damaged geotextile shall be repaired in accordance with Section 404 or replaced as directed.

309.6 METHOD OF MEASUREMENT. Random and grouted rip-rap shall be measured by the square yard, in place. Sacked rip-rap shall be measured by the cubic yard, in place. No measurement will be made for any necessary excavation, backfilling, and preparation of ground surfaces, but the cost of this work will be included in the price paid for rip-rap in place.

309.7 BASIS OF PAYMENT. The accepted quantities of sacked rip-rap will be paid for at the contract unit price per cubic yard of rip-rap in place, and random and grouted rip-rap will be paid for at the contract unit price per square yard of rip-rap in place, which price and payment shall include full compensation for furnishing all labor, materials, tools and equipment and doing all work involved in placing the rip-rap as shown on the plans and specified herein.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
309(1)	Sacked Concrete Rip-rap	Per Cubic Yard
309(2)	Grouted Rubble Rip-rap	Per Square Yard
309(3)	Random Rip-rap	Per Square Yard

SECTION 310

TEMPORARY EROSION CONTROL

310.01 DESCRIPTION. This work consists of constructing and maintaining temporary erosion control features shown on the plans or as directed. Installation of temporary erosion control features shall be coordinated with construction of permanent erosion control features to the extent necessary to ensure economical, effective and continuous control of erosion and water pollution throughout the life of the contract.

The contractor shall submit an erosion control plan to the City before beginning clearing or earthwork operations. In cases where one or more acres of land-altering activities occur, a storm water pollution prevention plan (SWPPP) must be submitted instead of an erosion control plan. The SWPPP must meet all requirements of the applicable State construction permit. The plan shall indicate the use of contract items and the coordination of this work with the scheduling of clearing and earthwork. The use of erosion control features or methods other than those in the contract shall be as directed.

The Notice of Intent will be submitted by the City to the State prior to the project letting. The project engineer will complete and submit the Notice of Termination to the State after project acceptance.

310.02 CONTROL OF ERODIBLE SOIL.

- (a) **General:** The contractor shall prevent the transmission of soil particles into streams, canals, lakes, reservoirs or other waterways. Except as necessary for construction, excavated material shall not be deposited into streams or impoundments, or in a position close enough to be washed in waterways by high water or runoff. The contractor shall not disturb lands or waters outside the limits of construction, except as authorized.
- (b) **Adjacent to Waterways:** Stream banks shall be kept in their natural state. The contractor shall not unnecessarily strip protective vegetation in the vicinity of stream banks and shall conduct operations without damage to banks. Banks shall not be excavated except as shown on the plans or as otherwise approved in writing. Work roads requiring bank cuts shall be approved by the project engineer prior to making such cuts. The banks shall be restored by the contractor to the satisfaction of the project engineer.
- (c) **Adjacent to Property:** The location of, and method of operation in, borrow pits, material pits and disposal areas obtained by the contractor for waste material from the project (other than commercially operated sources) shall be the contractor's responsibility.

310.03 MATERIALS. Materials not covered by project specifications shall meet commercial grade standards and shall be approved before being incorporated into the project. No testing of materials used in temporary erosion control features will be required. Acceptance of temporary erosion control materials will be by visual inspection.

- (a) **Mulches:** Mulch shall comply with Subsection 203.4 and emulsified asphalt shall conform to Section 204.3.
- (b) **Seeding:** Grass shall be an approved quick-growing species suitable to the area, providing a temporary cover which will not compete with permanent grasses. Rye grass is the only acceptable grass for winter cover.
- (c) **Slope Drains:** Slope drains may be constructed of pipe, fiber mats, rubble, portland cement concrete, asphaltic concrete, plastic sheets or other acceptable material.

- (d) **Fertilizer:** Fertilizer shall comply with Subsection 203.2.1.
- (e) **Silt Fencing:** Silt fencing shall be wire-supported or self-supported systems. Other silt fencing systems may be used when approved.
 - (1) **Wire-Supported:** Wire-supported silt fencing shall consist of standard woven livestock wire, and minimum of 14-gage (2.0 mm diameter) wire, a minimum of 36 inches (900 mm) in height with a maximum wire spacing of 6 inches (150 mm). Posts shall be either wood or steel installed a minimum of 2 feet (0.6 m) in the ground. Filter material shall be burlap weighing approximately 7 1/2 ounces per square yard (0.25 kg per sq m), approved jute fabric or approved geotextile fabric. Geotextile fabric shall comply with Section 210, Type F.
 - (2) **Self-Supported:** Self-supported silt fencing shall consist of an approved geotextile fabric suitably attached to posts of either wood or steel installed in accordance with plan details. Geotextile fabric shall comply with Section 211, Type G.
- (f) **Lime:** Agricultural lime shall comply with Subsection 1201.2.3.
- (g) **Temporary Construction Entrance:** Temporary construction entrances shall consist of stone or recycled portland cement concrete complying with Subsection 200.3, 2 lb (1 kg) class placed on geotextile fabric complying with Section 211 for use under riprap. The geotextile fabric underliner shall be placed at the locations designated for temporary construction entrances before stone or recycled portland cement concrete is placed. The stone or recycled portland cement concrete shall be placed and compacted to the required thickness as directed. This work also includes additional measures required to remove mud from truck tires, such as wash racks, etc.
- (h) **Hay Bales:** Hay or straw bales shall be rectangular bales, acceptable to the project engineer. The average length of bales shall be 34 inches (850 mm) minimum.

310.04 EXPOSURE OF ERODIBLE EARTH. The engineer may direct the contractor to provide immediate permanent or temporary erosion or pollution control measures to prevent contamination of streams, lakes, tidal waters, reservoirs, canals or other impoundments or prevent detrimental effects on property outside the right-of-way and damage to the project. Limitations of areas in which excavation and embankment operations are underway shall be commensurate with the contractor's capability and progress in keeping finish grading, temporary erosion control, and permanent erosion control measures in accordance with the accepted schedule.

310.05 INCORPORATION OF EROSION CONTROL FEATURES. Use of temporary erosion control features will be authorized to correct unforeseen conditions that develop during construction; to control erosion prior to the time it is practical to construct permanent control features; or to provide immediate temporary control of erosion that develops during normal construction operations but is not associated with permanent erosion control features. Permanent erosion control features shall be incorporated into the project at the earliest practical time. Temporary erosion control features will be used as directed in areas where stage construction or other conditions not under control of the contractor preclude completion of a section of roadway in a continuous manner, or where subsequent construction operations will cause damage to permanent erosion control features.

310.06 CONSTRUCTION REQUIREMENTS. Temporary erosion control features shall consist of, but not be limited to, temporary seeding, temporary mulching, sandbagging, slope drains, sediment basins, sediment check dams, erosion checks, artificial coverings, berms, and stone entrances. The engineer may direct use of temporary erosion control features or methods other than those included in the original contract. Soil deposits outside the right-of-way shall be immediately removed and the surface repaired at no direct pay. The engineer shall have the authority to require the contractor's operations to be discontinued until erosion deposits have been cleared and the area restored.

- (a) **Temporary Seeding:** Seeding shall be done in accordance with Section 1201, except that ground preparation will be limited to blading the area. Lime or fertilizer shall be applied in accordance with Section 1201; however, lime or fertilizer may be omitted or the application rate reduced as directed.
- (b) **Temporary Mulching:** Mulch and emulsified asphalt shall be furnished and applied in accordance with Section 1201. Mulch may be omitted or the application rate reduced as ordered. When permanent seeding operations begin, temporary mulch materials shall be plowed under during ground preparation.
- (c) **Sandbagging:** Sandbags shall be placed as directed.
- (d) **Baled Straw or Hay:** Baled straw or hay shall be placed as directed to form checks or dams to control erosion and siltation. Bales shall be properly staked or otherwise secured as directed, as shown on the plans. The bales shall be buried as necessary to prevent scour under the bales. A minimum of 2 stakes shall be driven through each bale.
- (e) **Slope Drains:** Slope drains shall be constructed with acceptable materials in accordance with plan details or as directed, if necessary to prevent scour. The discharge area shall be stabilized or protected by temporary riprap as directed. Cost of discharge area protection will be included under the slope drain item.
- (f) **Sediment Basins:** Sediment basins shall be constructed in accordance with plan details or as directed.
- (g) **Sediment Check Dams:** Check dams shall be constructed at locations shown on the plans or as directed. Check dams shall be constructed before clearing and grubbing or grading in the area is begun unless otherwise directed.
- (h) **Silt Fencing:** Silt fencing shall be furnished and constructed at designated locations or other locations, as directed by the engineer.
- (i) **Berms:** Earth berms shall be constructed as directed to divert the flow of water from erodible surfaces.
- (j) **Unforeseen Conditions:** When unforeseen conditions are encountered, the engineer may direct the contractor to construct such temporary devices as required to control erosion during construction. Details may be developed jointly by the engineer and the contractor.
- (k) **Maintenance of Erosion Control Features:** Temporary erosion control devices shall be inspected and maintained as described below or replaced as directed at no direct pay.
 - (1) **Temporary Seeding:** The seeded areas shall be inspected after each rainfall and areas showing erosion shall be reseeded if necessary.
 - (2) **Mulches:** The mulched areas shall be inspected after each rainfall and the mulch shall be repaired or reapplied if necessary.
 - (3) **Straw or Hay Bale Barriers:** The bale barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Close attention shall be paid to the repair of damaged bales, "end runs" and undercutting beneath bales.
 - (4) **Slope Drains:** Slope drains shall be inspected weekly and after every rainfall and repairs made if necessary. The contractor shall avoid the placement of any material on and prevent construction traffic across the slope drain.
 - (5) **Sediment Check Dams:** The check dams shall be inspected after each rainfall and sediment shall be removed when it reaches one-half the height of the check dam. Inspections shall be made to insure that the center of the dam is lower than the edges. Erosion around the edges shall be corrected immediately.
 - (6) **Silt Fencing:** Sediment deposits shall be removed after each rainfall and must be removed when the deposits reach approximately one-half the height of the fence. If the fabric on the silt fence decomposes or becomes ineffective, the fabric shall be replaced promptly.
 - (7) **Temporary Stone Construction Entrance and/or Wash Racks:** The construction entrance shall be maintained to allow for removal of mud from the tires. The sediment from the wash rack runoff

shall be removed periodically.

(I) Removal of Temporary Erosion Control Features: Temporary erosion control features existing at the time of construction of permanent erosion control features shall be removed or incorporated into the soil in such manner that no detrimental effect will result. The engineer may direct that temporary features be left in place. Sediment in sediment basins, silt fences, check dams, and other catchment areas shall be removed, replaced with acceptable soils in accordance with Subsection 203.1, and compacted as directed at no direct pay.

310.07 PROTECTION DURING SUSPENSION OF OPERATIONS. Prior to the suspension of operations, the contractor shall shape the top of the earthwork in such manner as to permit runoff of rainwater and shall construct earth berms along the top edges of embankments to intercept runoff water. Temporary slope drains shall be provided in the earth berm to carry runoff. When such preventive measures fail, the contractor shall immediately take other action as necessary to prevent erosion and siltation. The engineer may direct the contractor to perform other erosion control work during suspensions of contract time.

310.08 MEASUREMENT. When temporary erosion and pollution control measures are required due to the contractor's negligence or failure to install permanent controls, such work shall be performed by the contractor at no direct pay. Required temporary erosion and pollution control work which is not due to the contractor's negligence will be measured as follows: When separate items for temporary erosion control devices are included in the contract, and the work is ordered, the quantities to be paid for will be the weight in pounds (kg) of temporary seeding and in tons (Mg) of temporary mulching; the volume in cubic yards (cu m) of sandbagging with the measurement of sand being made in a batch box or other satisfactory means; the number of hay bales placed; the length in feet (m) of temporary slope drains measured along the ground surface and silt fencing measured along ground surface between end posts; the number of sediment basins and sediment check dams acceptably constructed; the number of gallons (L) of emulsified asphalt, and the number of construction entrances.

Temporary erosion control items may be eliminated when conditions do not justify their use. When temporary erosion control work is ordered and is not covered by contract items, the work shall be performed as extra work in accordance with Section 105.3 except that no extra work order will be required prior to starting work. The construction of temporary earth berms along edges of the roadway to prevent erosion during grading and subsequent operations will not be measured for payment.

In case of failure of the contractor to control erosion, or siltation, the engineer may employ outside assistance or use his own forces to provide the necessary corrective measures, and the cost thereof will be deducted from payments for the work. Partial payments will be withheld until satisfactory temporary erosion control is established.

310.09 PAYMENT. Payment for temporary erosion control items that are included as contract items will be made at the contract unit prices. Payment for temporary mulching, emulsified asphalt and seeding will be made under Section 1201.9. Temporary erosion control work not covered by contract items that is ordered will be paid for in accordance with Section 105.2.2. Temporary sandbagging and baled hay or straw will be paid for directly when used other than in construction of temporary slope drains, temporary sediment basins and temporary sediment check dams. When sandbags and baled hay or straw are used in construction of slope drains, sediment basins and sediment check dams, payment will be made under these items. Payment for devices used to correct unforeseen conditions will be made at the contract unit price for similar devices shown on the plans, or as extra work if plan details are not applicable. Payment will be made under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
310-01	Temporary Sandbagging	Cubic Yard
310-02	Temporary Hay or Straw Bales	Each
310-03	Temporary Slope Drains	Linear Foot
310-04	Temporary Sediment Basins	Each
310-05	Temporary Sediment Check Dams	Each
310-06	Temporary Silt Fencing	Linear Foot
310-07	Temporary Stone Construction Entrance	Each

PART 4

ROADWAY SUBGRADE PREPARATION AND BASE COURSE

SECTION 401

SUBGRADE PREPARATION

401.1 GENERAL. This section shall govern the preparation of natural, filled or excavated roadbed material prior to the placement of sub-base or base material, pavement, curbs and gutters, driveways, sidewalks or other roadway structures. The Contractor shall be responsible for protection of the subgrade during construction.

401.2 PREPARATION OF SUBGRADE. Scarifying and compacting will be required for dry soils which are impervious to the penetration of water, for soils which contain excessive amounts of moisture which may result in unstable foundations, for soils which are non-uniform in character which may result in non-uniform relative compactions and subsequent differential settlements of finished surfaces, or when pavement is to be placed directly on existing roadbed material.

After rough grading has been completed, and when scarifying and compacting are required, the roadbed shall be loosened to a depth of at least 6 inches (150 mm). The loosened material shall then be worked to a finely divided condition and all rocks larger than 3 inches (75 mm) in diameter shall be removed. The moisture content shall be brought to optimum by the addition of water, by the addition and blending of dry suitable material or by the drying of existing material. The material shall then be compacted by approved equipment to the specified relative compaction.

Uniform pervious soils, that allow the immediate penetration of water or uniform impervious soils which will allow the penetration of water to a depth of at least 6 inches (150 mm) after the addition of a suitable wetting agent, will not require scarifying unless a condition previously set forth in this subsection requires such processing. When scarifying is not required, the moisture content of the top 6 inches (150 mm) of the subgrade material shall be brought to optimum by the addition of water at the surface, and the material shall be compacted by approved equipment to the specified relative compaction.

401.3 LIME TREATMENT OF SUBGRADE.

401.3.1 General. Lime treatment subgrade shall consist of the treatment of one or more courses of subgrade material with hydrated lime mixed, compacted and finished to conform to the lines, grades, thicknesses and typical cross-sections as indicated on the Drawings. It includes furnishing, hauling, and spreading of the lime.

401.3.2 Materials. Lime shall be as specified in Subsection 201.6. Water shall be as specified in Subsection 201.1.4.

401.3.3 Equipment. Shall be as specified in Section 402.

401.3.4 Mixing. Where designated, the depth of subgrade indicated on the Drawings shall be treated with commercial grade hydrated lime. The percentage of lime to be incorporated shall be as specified on the Drawings, or project specifications, or as established by the Engineer.

401.3.5 Mixing. Where designated, the depth of subgrade shown on the plans shall be treated with amounts of commercial grade hydrated lime as established by the Engineer. The lime may be placed on the subgrade in either dry form or may be applied as a slurry. The lime or lime slurry shall be thoroughly mixed with the material to be treated as soon as practical. The contractor shall handle the processing of lime in such a manner that lime dust will not be hazardous to workmen nor to the public. Initial mixing shall be performed the same day the lime is placed. After preliminary mixing, the section so treated shall be shaped, lightly compacted and cured for a period of 48 hrs. or as directed by the Engineer. During the curing period, the moisture content of the mixture shall be maintained from 2 to 5 percent above the optimum required for compaction.

Following the curing period, the contractor shall again mix the treated material until 100% of the slaking fraction passes the 1½ inch (38.1 mm) sieve and a minimum of 70% passes the No. 4 sieve using approved road mixers or other approved equipment which is capable of thoroughly mixing and processing the combined materials.

401.3.5 Compaction and Grading. Compaction shall begin immediately after the final mixing. Each course of lime treated subgrade shall be compacted to 90% of maximum density, as determined by AASHTO Designation T-180, Method A, except that when pavement, curb, gutter, driveways, sidewalks, or other structures are to be placed directly upon the lime treated material the top 6 inches (150 mm) thereof shall be compacted to 95% of maximum density, and in accordance with the applicable provisions of Subsection 401.5.

When compacting and shaping are completed, the subgrade shall be kept moist until the first layer of base or other surfacing material has been placed, in order to prevent shrinkage cracks.

401.4 CEMENT TREATMENT OF SUBGRADE. Sub-base treatment with portland cement shall be constructed in accordance with the requirements of Section 402.

401.5 COMPACTION. The top 6 inches (150 mm) of subgrade material shall be compacted to a relative compaction of 95%. After compaction and trimming, the subgrade shall be firm, hard, and unyielding. Prior to placement of base material, the contractor shall be required to test the subgrade with an approved mechanical device.

401.6 SUBGRADE TOLERANCES. Subgrade for pavement, sidewalks curb and gutter, driveways, or other roadway structures shall not vary more than 0.02 foot (6 mm) from the specified grade and cross-section. Subgrade for sub-base or base material shall not vary more than 0.04 foot (12 mm) from the specified grade and cross-section. Variations within the above specified tolerances shall be compensating so that the average grade and cross-section specified are met.

401.7 GRADING OF AREAS NOT TO BE PAVED. Roadway areas shall be graded to meet the tolerances for base subgrade. The surface shall be constructed to a straight grade from the finish pavement or curb elevations shown on the plans to the elevation of the existing ground at the extremities of the area to be graded.

401.8 ADJUSTMENT OF MANHOLE FRAME AND COVER SETS TO GRADE. Utility manhole and vault frames and covers within an area to be paved or graded will be set by the owners thereof to finish grade. Sewer and storm drain manhole frames within the area to be paved or graded shall be set to finish grade by contractor. Manholes in asphaltic concrete pavement shall be set to finish grade. In the case of portland cement concrete pavement, manhole frames shall be set to finish grade before paving. Repaving required as a result of reconstructing or adjusting all manhole and vault frames and covers to grade shall be the responsibility of the contractor and the cost

thereof shall be included in the bid item for pavement.

401.9 PAYMENT. Payment for preparing a subgrade will be considered as included in the item of work for which the subgrade is prepared.

Payment for grading operations in areas designated as "grade only" will be considered as included in the price for excavation or fill.

Payment for adjusting manhole frames and covers to grade, will be made under Section 601.

Payment for lime treated subgrade, except for the payment for hydrated lime, will be made on the basis of the price bid per square yard for the processing and compaction of the lime treated material complete in place for the widths and thicknesses shown on the plans. Payment for hydrated lime will be made on the basis of the price bid per one hundred pounds, dry weight, delivered and placed as directed by the Engineer. Payment for cement treatment of sub-base shall be made as specified in Section 402, "Soil Cement Base".

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
401(1)	Soil-Lime Processing 6 IN Depth	Per Square Yard
401(2)	Soil-Lime Processing 8 IN Depth	Per Square Yard
401(4)	Soil-Lime Processing 12 IN Depth	Per Square Yard
401(5)	Hydrated Lime	Per CWT

SECTION 402

SOIL CEMENT BASE

402.1 GENERAL. This work consists of scarifying, pulverizing, blending, shaping and stabilizing select material or the existing roadbed material with portland cement in accordance with these specifications, in reasonably close conformity with the lines, grades, thickness and sections shown on the plans or established by the Engineer. For bid purposes, the estimated rate of portland cement required for stabilization is 10% by volume; however, the actual rate of portland cement to be used for stabilization will be determined by an independent laboratory employed by the City. If the actual rate of cement differs from the estimated rate, an adjustment will be made for this difference, as specified in Subsection 402.8.

402.2 MATERIALS. Materials shall conform to the following subsections:

Cement	201.1.2
Water	201.1.4
Emulsified Asphalt	204.3
Cutback Asphalt	204.2

402.2.1 Soil. Soil shall consist of the material existing in the area to be paved, or of an approved imported select soil or of a combination of these materials proportioned as directed by the Engineer. Soil for soil cement base course shall consist of materials that will stabilize with cement. Soil with a liquid limit greater than 35, a plasticity index greater than 15 shall not be used.

402.3 EQUIPMENT. Equipment necessary to produce a finished base course which meets specification requirements shall be furnished and maintained by the contractor. Mixing machines shall be approved by the Engineer prior to use.

402.4 PREPARATION OF ROADBED. The contractor shall scarify and pulverize the materials to be stabilized for the full width and depth of the cement stabilized base course. If the existing roadway has asphaltic surfacing the surfacing shall be pulverized and uniformly mixed with the materials below the surfacing. Any surfacing materials or base materials which cannot be pulverized to the satisfaction of the Engineer shall be removed from the roadway and disposed of as directed by the Engineer, all at no cost to the City.

Test samples will be taken after the materials have been thoroughly pulverized and blended. Materials failing to meet specifications shall not be stabilized until the necessary corrective measures have been taken to assure compliance. After the roadbed has been prepared as specified above, the contractor shall shape the roadbed to the required section and uniformly compact the roadbed material to the satisfaction of the Engineer.

402.5 CONSTRUCTION METHODS. Depending upon existing conditions, construction methods shall facilitate either mixing of materials with in place soil or plant mixing of soil and materials. The method to be used shall be indicated on the Drawings or as directed by the Engineer.

402.5.1 In-Place Soil.

402.5.1.1 Mixing. After the roadbed material to be stabilized has been prepared, portland cement shall be uniformly spread and mixed with the material and shaped to the required section. Prior to mixing, the percent of cement to be used for stabilization will be determined by laboratory tests in accordance with Louisiana DOTD Designation: TR 432 and the method of mixing shall be such that the amount of cement used can be readily determined.

Water shall be added as needed by means of the mixer and shall be uniformly incorporated in the mixture in the amounts required to attain the optimum moisture content specified for the mixture. The optimum moisture of the mixture will be determined by the laboratory tests in accordance with Louisiana DOTD Designation: TR 418. The percentage of moisture in the mixture on the basis of dry weight shall not vary from the specified optimum percentage of moisture by more than $\pm 2\%$ at the time of compaction.

402.5.1.2 Placing, Compacting, and Finishing. Soil-cement shall be uniformly compacted to at least 95% of relative compaction. The mixture shall be placed on the moistened subgrade, or previously completed soil-cement, using mechanical spreading equipment that will produce layers of such width and thickness that it will compact to the required dimensions of the completed soil-cement layers.

The mixture may be spread and compacted in one layer where the required thickness is 8 inches (200 mm) or less. Where the required thickness is more than 8 inches, the mixture shall be spread and compacted in two or more layers of approximately equal thickness, provided that the maximum compacted thickness of any one layer does not exceed 8 inches (200 mm). Compaction shall commence within 30 minutes after being placed on the grade and shall proceed continuously until complete. Final compaction of the mixture to the specified density shall be completed within 2 ½ hours after the application of water during the mixing operation.

When two or more layers of soil-cement are to be placed, the surface which will be in contact with succeeding layers shall be kept continuously moist for 7 days or until the placement of the subsequent layer. Any loose material on the surface of the completed layer shall be removed and the surface moistened immediately before placement of the next layer. No standing water will be permitted. At the start of compaction, the mixture shall be in a uniform, loose condition throughout its full depth.

During finishing operations, the surface of the soil-cement shall be shaped to the required lines, grades and cross-section and shall be kept moist. The finished surface of the soil-cement shall conform to the requirements of Subsection 401.6.

402.5.2 Plant Mixing.

402.5.2.1 Mixing. The soil materials shall be combined with portland cement and water by travel plant, central plant or other approved methods and shaped on the approved subgrade. Water needed to bring the moisture content of the mixture to within the tolerance specified herein shall be added and uniformly mixed with the materials. If prior to spreading the cement the moisture content of the soil is excessive, the soil shall be manipulated until the moisture content is such that the tolerance specified herein for the mixture can be met.

The percentage of cement will be determined in accordance with Louisiana DOTD Designation: TR 432 prior to mixing. The method of mixing shall be such that the amount of cement used can be readily determined. When central

plant mixing is used, a reduction of 1 percent in the volume of cement required will be permitted.

The optimum moisture of the mixture will be determined by the Laboratory in accordance with Louisiana DOTD Designation: TR 418. The percentage of moisture in the mixture, on the basis of dry weight, shall not vary from the specified optimum percentage of moisture by more than ± 2 percent at the time of compaction. A minimum of 70 percent of the pulverized soil, as determined by Louisiana DOTD Designation: TR 431, shall pass the No. 4 sieve after mixing.

402.5.2.2 Transporting and Placing on Subgrade. Transportation and spreading methods shall be such that minimum damage is done to the subgrade. It shall be the contractor's responsibility to place and spread sufficient material to obtain required width and compacted thickness. Every effort shall be made to prevent subgrade materials from contaminating the base course. Such contamination will require retesting and correction of deficiencies. Base course materials shall not be placed, spread or mixed on portland cement concrete or asphaltic concrete pavements, and base course construction operations shall be conducted in such manner that pavement surfaces, edges and joints are not damaged.

402.5.2.3 Compacting and Finishing. The mixture shall be uniformly compacted immediately upon completion of mixing or placement. The number and type of rollers used shall be sufficient to uniformly compact the base course to the specified depth and width, and within the specified time. Vibratory rollers will not be permitted in areas with high water tables. The surface shall be kept uniformly moist at all times during compaction and final finishing. For soil containing 65 percent or more silt, classified as silty loams or silts, and having a plasticity index of 5 or less, compaction shall be by a sheep's foot or similar type roller followed by a light pneumatic roller not exceeding 10 tons.

Compaction shall continue until the base course density or degree of compaction is 95%. Degree of compaction shall be the percent of the material in its original undisturbed state as determined by ASTM-1557 maximum density at or above optimum moisture content. At all places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted using devices that will obtain uniform compaction to required density without damage to adjacent structures. All compaction shall be completed within 3 hours after initial mixing of cement with base course materials.

Upon expiration of the 3-hour period after initial mixing, only blading of the base course surface will be allowed, and the bladed material shall not be drifted along the base but shall be wasted on the shoulders. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, waves, laminations, loose material or laitance.

402.6 CURING. After placement and compaction of the soil-cement is completed, it shall be protected against drying and from traffic for 72 hours. Curing shall be moist (water fogging), bituminous seal, or other method approved by the Engineer. If moist curing is used, exposed surfaces of the soil-cement shall be kept continuously moist with a fog spray for 72 hours. If a bituminous curing is used, it shall consist of liquid asphalt or emulsified asphalt.

The bituminous curing seal shall be applied in sufficient quantity to provide a continuous membrane over the soil-cement at a rate of between 0.10 and 0.20 gallons per square yard (0.45 and 0.91 liter per m²) of surface with the exact rate determined by the Engineer. It shall be applied as soon as possible after the completion of final rolling. The surface shall be kept moist until the seal is applied. At the time the bituminous material is applied, the soil-cement surface shall be dense, shall be free of all loose and extraneous material, and shall contain sufficient moisture to prevent excessive penetration of the bituminous material.

402.7 REPAIR. If the soil cement is damaged, it shall be repaired by removing and replacing the entire depth of affected layers in the damaged area. Feathering will not be permitted for repair of low areas.

402.8 MEASUREMENT AND PAYMENT. Cement treated soils, base, and subbase will be paid for by the square yard in place as shown on the plans or as directed by the Engineer. The unit price shall include payment for all materials, labor and equipment used in the treated mixture, mixing, spreading, shaping, compacting, trimming, and curing.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
402(1)	In-Place Soil Cement Base Course	Square Yard

SECTION 403

BASE COURSE

403.1 AGGREGATES

403.1.1 General.

A) Untreated crushed stone base for pavement, curb, gutter and similar improvements shall be constructed of material as specified in Subsection 200.3.1.

B) Untreated crushed aggregate base for pavement, curb, gutter and similar improvements shall be constructed of material as specified in Subsection 200.3.1 or of crushed concrete as specified in Subsection 200.3.2.

403.1.2 Spreading. Imported aggregate bases shall be delivered to the roadbed as uniform mixtures, and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free from pockets of coarse or fine material.

Aggregate bases shall be deposited on the roadbed at a uniform quantity per linear foot, which quantity will provide the required compacted thickness within the tolerances specified herein without resorting to spotting, picking up or otherwise shifting the aggregate base material. At the time aggregate base is spread, it shall have a moisture content sufficient to obtain the required compaction. Such moisture shall be uniformly distributed throughout the material.

Where the required thickness is 0.50 foot (150 mm) or less, the base material may be spread and compacted in one layer. Where the required thickness is more than 0.50 foot (150 mm) the base material shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 0.50 foot (150 mm). Each layer shall be spread and compacted in a similar manner.

When subgrade for aggregate base consist of cohesionless sand and written permission is granted by the Engineer, a portion of the aggregate base may be dumped in piles upon the subgrade and spread ahead from the dumped material in sufficient quantity to stabilize the subgrade. Segregation of aggregates shall be avoided and the material as spread shall be free from pockets of coarse or fine material.

403.1.3 Compacting. Rolling shall always be commenced along the edge of the area to be compacted and the roller shall gradually advance toward the center of the area to be compacted. Rollers shall be operated along lines parallel or concentric with the center line of the road being constructed, and no material variation there from will be permitted. All rollers must be maintained in good mechanical condition.

Unless otherwise specified, the relative compaction of each layer of compacted base material shall not be less than 95%. The surface of the finished aggregate base at any point shall not vary more than 0.02 foot (6 mm) above or below the grade established by the Engineer. Base which does not conform to the above requirements shall be reshaped or reworked, watered and thoroughly recompacted to conform to the specified requirements.

403.2 SAND-CLAY-GRAVEL

403.2.1 General. Sand-clay-gravel base shall consist of furnishing and placing a base course of sand-clay-gravel on a prepared subgrade in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer. It includes furnishing, hauling, placing, spreading, watering, compacting and maintaining the base course.

403.2.2 Materials. Sand-clay-gravel base shall be constructed of base material specified in Subsection 200.3.3 unless otherwise specified on the Drawings. The sand-clay-gravel shall be completely mixed and tested by an approved testing laboratory, to determine that it meets the specifications, before it is hauled to the job site. The Engineer may reject material which requires the addition of more than 5% additive on the job site to meet the specified requirements, but in any event the Contractor shall not be relieved from the responsibility of providing a base composed of sand-clay-gravel which meets the specifications.

403.2.3 Equipment. All necessary equipment shall be on the project, in satisfactory working condition, and shall have been approved before construction begins. Spreading equipment shall be of such weight and type to adequately spread the material. Rollers or other equipment used to compact base may be any approved type or combination of types that will obtain the required density. Provisions shall be made by the Contractor for furnishing sufficient water at the work site. Water vehicles or other approved sprinkling devices shall be provided.

403.2.4 Preparation of Subgrade. Unless otherwise shown on the plans the preparation of subgrade shall be completed in accordance with the requirements of Section 401 prior to the placing of base course material.

403.2.5 Placing of Material. Sand-clay-gravel base 6 inches (150 mm) or less in compacted thickness may be placed in a single layer and those more than 6 inches (150 mm) in thickness shall be built up in successive layers of approximately equal compacted thickness not to exceed a maximum thickness of six inches (150 mm).

The pre-mixed base material may be dumped directly on the prepared subgrade, but it shall be uniformly distributed over the subgrade either by hand or from approved spreaders or other mechanical equipment. When using mechanical equipment for spreading material, dump piles shall be so spread as to insure uniform compaction of the material. Transportation and spreading methods shall be such that minimum damage is done to the subgrade. Every effort shall be made to prevent materials from the subgrade from becoming mixed with or incorporated into the aggregate mix. Such introduction will require retesting and correction of deficiencies.

403.2.6 Compaction and Shaping. After distribution, the base material shall be watered and then immediately bladed to a uniform layer that will net the required thickness after rolling. If the materials deposited are not uniformly blended together, the blading operation shall be continued to such extent as may be necessary. The quantity of water applied shall be that amount which will assure optimum moisture under proper compaction resulting in a relative compaction of not less than 95% as determined by a laboratory test, using AASHTO Designation T 180, Method A, except that the compaction test shall be accomplished in three layers using 25 strokes of the rammer per layer, care being exercised in connection with watering operations to avoid wetting the subgrade or any lower base course to detrimental extent. Upon completion, the base shall be firm, hard and unyielding, with a true, even and uniform surface conforming to the grade and cross-section specified.

Sand-clay-gravel base may vary not more than 1/2 inch above or below required grade and cross section, except that the compacted base for bituminous pavements may vary not more than 1/4 inch above or below required grade and cross

section provided such variations are compensating.

When a new sand-clay-gravel base course is constructed on an existing gravel base the old base material shall be scarified slightly and blended and mixed with the first course of new material added. The cost of this work shall be included in the cost of constructing the sand-clay-gravel base course.

403.3 SAND

403.3.1 Description. Sand base shall consist of furnishing and placing a base course of sand on a prepared subgrade in accordance with these specifications, in reasonably close conformity with lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer. It includes furnishing, hauling, placing, spreading, watering, compacting and maintaining the base course.

403.3.2 Materials. Sand shall conform to the provisions of Subsection 200.1.

403.3.3 Equipment. All necessary equipment shall be on the project, in satisfactory working condition, and shall have been approved before construction begins. Spreading equipment shall be of such weight and type to adequately spread the material. Rollers or other equipment used to compact base may be any approved type or combination of types that will obtain the required density. Provisions shall be made by the Contractor for furnishing sufficient water at the work site. Water vehicles or other approved sprinkling devices shall be provided.

403.3.4 Preparation of Subgrade. Unless otherwise shown on the plans, the preparation of subgrade shall be completed in accordance with the requirements of Section 401 prior to the placing of base course material.

403.3.5 Placing of Material. Transportation and spreading methods shall be such that minimum damage is done to the subgrade. The base course shall be placed in one or more approximately equal layers as necessary and as directed in order to obtain the required compaction. The thickness of each layer shall in no event exceed 6 inches (150 mm) compacted thickness. It shall be the contractor's responsibility to place and spread sufficient material to obtain required width and compacted thickness. Every effort shall be made to prevent materials from the subgrade from becoming mixed with or incorporated into the aggregate mix. Such introduction will require retesting and correction of deficiencies.

403.3.6 Compaction and Shaping. The requirements for compacting, shaping and testing shall be in conformance with those set forth in Subsection 403.2.6 "Compacting and Shaping" for sand-clay-gravel base course.

403.3.7 Measurement and Payment. Quantities of aggregate base will be measured by ton, cubic yard, or square yard, as shown in the Proposal. The volumetric or area quantities of base material shall be those of the compacted base in place within the limits of the dimensions shown on the plans.

The weight of material to be paid for will be determined by deducting (from the weight of material delivered to the work) the weight of water in the material (at the time of weighing) in excess of one percentage point more than the optimum moisture content. No payment will be made for the weight of water deducted as provided in this subsection.

Payment shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing aggregate base, complete in place, as shown on the plans, and as specified in these

specifications and as directed by the Engineer.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
403(1)	Crushed Stone Base Course	Cubic Yard
403(2)	Crushed Stone Base Course	Square Yard
403(3)	Crushed Aggregate Base Course	Ton
403(4)	Crushed Aggregate Base Course	Cubic Yard
403(5)	Crushed Aggregate Base Course	Square Yard
403(6)	Sand-Clay-Gravel Base Course, Grade A	Per Cubic Yard
403(7)	Sand-Clay-Gravel Base Course, Grade B	Per Cubic Yard
403(8)	Sand Base Course	Per Cubic Yard

SECTION 404

BASE REINFORCEMENT

404.1 GEOTEXTILE FABRICS.

404.1.1 General. This work consists of furnishing and placing geotextile fabric in accordance with these specifications and in conformance with the details shown on the plans.

404.1.2 Materials. The geotextile fabric shall comply with Section 211.

404.1.3 Construction Requirements. Rolls of geotextile fabric shall be kept covered and protected from ultraviolet degradation at all times until use. Geotextile fabric that has been installed shall be covered with embankment within 7 calendar days. When ultraviolet damage occurs, the geotextile fabric shall be removed and replaced. The geotextile fabric shall be placed at the locations shown on the plans or as directed. Adjacent rolls of geotextile fabric will be overlapped or sewn. When rolls are overlapped, the overlap shall be a minimum of 18 inches (450 mm), or as specified in the plans, including the ends of the rolls.

The top layer of the geotextile fabric shall be parallel with adjacent rolls and in the direction of embankment placement. When rolls are sewn, the contractor shall join adjacent rolls by sewing with polyester or kevlar thread. Field sewing shall employ the "J" seam or "Butterfly" seam with the two pieces of geotextile fabric mated together, turned in order to sew through 4 layers of fabric and sewn with 2 rows of Type 401, two-thread chain stitch. Factory seams other than specified may be submitted to the Project Manager for approval.

Where the ground is covered with water or soil is saturated, sewing of the geotextile fabric will be required. The geotextile fabric shall be placed as smooth as possible with no wrinkles or folds, except in curved road sections. For curved road sections, the geotextile fabric shall be folded to accommodate the curve. The fold shall be in the direction of construction and pinned or stapled. Ruts that occur during construction shall be filled and compacted prior to placement of geotextile fabric. Damaged geotextile fabric shall be either removed and replaced with new geotextile fabric or covered with a second layer of geotextile fabric extending 2 feet (0.6 m) in each direction from the damaged area.

404.2 MEASUREMENT AND PAYMENT. The quantities of geotextile fabric for payment will be the design lengths as shown on the drawings. Design quantities will be adjusted if the Engineer makes change to adjust to field conditions, in plan errors are proven, or if design changes are made. Payment for geotextile fabric will be made on a square-yard basis as shown in the Proposal. The price bid for geotextile fabric shall be considered to include full payment for all materials, labor, equipment and incidentals required to place the geotextile fabric in accordance with the drawings or these specifications. Should no pay item be included in the proposal for this item and the typical sections or specifications call for the use of geotextile fabrics, then payment for this item shall be considered incidental to the cost of the pavement, embankment or other pay items.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
404(1)	Geotextile Fabric	Per Square Yard

SECTION 405

PAVEMENT UNDERSEALING

405.1 DESCRIPTION. This work shall consist of raising, filling voids, and undersealing existing cementitious and asphalt pavements at locations as indicated on Contract Work Orders or as directed by the Project Engineer, through implementation of the process described in Section 405.2 using polyurethane materials as described in Section 405.3.

The Contractor shall have a minimum of 4 years experience lifting concrete pavement, utilizing the process described in Section 405.2 and using polyurethane materials as described in Section 405.3. The Contract shall be for 2 years and on mutual agreement can be extended further for 2 additional years. The bid price may be increased in years 2, 3, & 4 of the Contract by a maximum of 5% per year, but in no event to exceed the change in the United States Bureau of Labor Statistics Consumer Price Index and/or Wholesale Price Index during the contract period. The minimum Contract Work Order shall be 5000 pounds.

The contract may be canceled without assigning any reasons after the first year either by the Owner or the Contractor with a 90-day notice.

405.2 PROCESS. The Contractor shall provide for all equipment, materials, labor, and supervision required for the work. The Owner will provide on-site inspection personnel and engineering oversight for any special project conditions and specific project. The Contractor shall, at a minimum, provide the following equipment for such projects:

- a. A truck-mounted pumping unit capable of injecting the high density polyurethane formulation beneath the pavements and controlling the volume of injected material along with the rate and magnitude of pavement lifting, if required.
- b. Pressure and temperature control devices to assure and maintain proper temperature and proportionate mixing of the polyurethane component materials. All necessary electric generators, compressors, heaters, hoses, containers, valves and gauges to efficiently conduct and control the project work.
- c. Pneumatic and electric drills capable of efficiently drilling 14-mm to 18-mm diameter injection holes through pavements up to one (1) meter thick.
- d. Suitable laser levels and/or dial indicator devices, used to insure that the pavement is raised to an even plane and to the required elevation.

A pavement profile from laser level readings or string lines shall be used to determine where the pavement needs to be raised. In the project area, a series of 14-mm to 18-mm diameter holes shall be drilled through the pavement and underlying base to an appropriate depth as determined by the Contractor. Care shall be taken to protect the pavement surrounding each hole from damage.

The material shall be injected through the drilled holes until all known or encountered voids under the pavement are filled. The rate and amount of material injection shall be determined by the Contractor. The Contractor shall be responsible for any pavement blowouts or excessive pavement lifting which may occur as a result of his work and shall repair the subject area to the satisfaction of the Project Engineer without additional cost.

Corrections to the grade of adjacent slab, if necessary and as determined by the Project Engineer, shall be made in the

same manner that is required for pavement that is raised. All raised pavements must match the existing grade or adjacent slabs that provide positive drainage. Final elevations shall be within 7-mm of the required elevations as determined by the profile of the Project Engineer.

The Contractor's injection nozzles shall prevent leakage during injection and shall be removed at completion or driven into the injection hole to a depth of 3.0 cm below the pavement surface. Holes shall be filled to the pavement surface with polyurethane material and a non-shrink grout. At the end of each work shift, the work area shall be left in a clean, swept, and neat condition.

405.3 POLYURETHANE MATERIAL. The material used for raising and undersealing pavements shall be a water blown, closed cell, high density polyurethane system. The material shall have a free rise minimum density of 48 kilograms per cubic meter (3.0 lbs./cubic ft.) and a minimum compressive strength of 40 PSI. The material shall be hydrophobic in its component reaction so that the injected product is not significantly compromised by soil moisture or free water under the pavement. The high density polyurethane formulation shall reach 90% of full compressive strength within 15 minutes from the time of injection.

405.4 TESTING AND DATA. In advance of contract work commencement, the Contractor shall provide to the Contract Administrator and/or the Project Engineer the following:

- a. Material Safety Data Sheets for all pertinent materials.
- b. A Certificate of Compliance from the manufacturer of the polyurethane component materials to be used. The certification shall include the results of density and compressive strength analysis performed in accordance with ASTM D 1622 and ASTM D 1621 respectively.
- c. A report from an Industrial Hygienist who has conducted a personnel, production vehicle, and typical job-site safety review of the Contractor's implementation procedures involving the polyurethane component chemicals.
- d. A satisfactory test, witnessed by the Project Engineer, of injection of the Contractor's polyurethane material into a 40-gallon container of ambient (70°F) temperature water. The resulting product shall demonstrate consistent closed cell polyurethane material. A list of 50 clients for which the Contractor has successfully completed polyurethane raising and/or undersealing pavement projects. The listing shall also contain contact names and phone numbers for the clients involved.
- e. A copy of the Contractor's Employee Safety Manual specific to polyurethane pavement raising and undersealing work.

405.5 MEASUREMENT AND PAYMENT. Payment for all work done shall be determined by the Project Engineer and the Contract. The Contractor shall be paid per pound of material injected based upon the Contract unit price. The quoted price and payment shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals for all work as called for in this specification, or as directed by the Project Engineer.

At the request of the Inspector, all pumping units in service shall perform a product density test by injecting a sample of the unit's polyurethane material into a test cylinder of known volume. The sample's net weight and density result shall be witnessed by the Inspector or the Project Engineer. The density shall not be less than the requirement of Section

405.3 above. The Owner may test the contents and quality of the polyurethane at the Owner's expense at any time. Daily material usage shall be attested by the Inspector and the Contractor and reported on a field production report.

<u>ITEM NO.</u>	<u>ITEM</u>	<u>PAY UNIT</u>
405(1)	Pavement Undersealing	Lbs.

PART 5

SECTION 501

AGGREGATE SURFACE COURSE

501.1 DESCRIPTION. This work consists of constructing an aggregate surface course for roadway, shoulders or driveways entrances in accordance with these specifications, and in reasonably close conformity with the lines, grades, thicknesses and typical sections shown on the plans or established by the Engineer.

501.2 MATERIALS. Aggregate surface course shall, at the option of the contractor, be gravel with binder, crushed stone with binder, sand clay gravel. Approximately 60% gravel or crushed stone shall be mixed with 40% binder.

Materials shall conform to the following Subsections:

Gravel	200.4.1
Crushed Stone	200.4.2
Binder	200.4.3

501.3 SUBGRADE. The subgrade shall be prepared as provided for in Section 401 and shall be approved before any surfacing material is placed. On existing shoulders, all vegetation shall be removed and the shoulders shall be shaped and compacted to the satisfaction of the Engineer prior to placing aggregate surfacing. Material removed from shoulders shall be uniformly spread on adjacent slopes. Preparation of existing shoulders will be considered as incidental to the aggregate surfacing and no separate payment will be made therefor.

501.4 PLACING MATERIAL. The material shall be deposited directly on the subgrade from vehicles used for hauling or from spreading equipment. No surface course shall be placed on a muddy or rutted subgrade. Aggregate surfacing materials shall not be placed or spread on portland cement concrete or asphaltic concrete pavements, and aggregate surfacing operations shall be conducted in such manner that pavement surfaces, edges and joints are not damaged.

501.5 MIXING. Aggregate surfacing consisting of a combination of materials shall be uniformly mixed prior to placing on the subgrade. The mixed materials shall conform to the requirements specified in Subsection 501.2 prior to placement on the subgrade.

501.6 SHAPING AND COMPACTING. The material shall be shaped by suitable means while being compacted. Any ruts formed shall be filled by blading as often as necessary to prevent breaking through the surfacing material into the subgrade. Holes, waves, and deficiencies in thickness which may develop and are not filled by blading shall be filled by adding more material. Shaping and compacting shall continue until the surface reasonably conforms to the cross sections shown on the plans and until it is free from ruts and waves.

501.7 METHOD OF MEASUREMENT.

501.7.1 Net Section. The quantities of aggregate surface course for payment will be the design volumes as

specified in the plans and adjustments thereto. Design quantities are based on the horizontal dimensions and the compacted thickness of the completed aggregate surface course shown on the plans. Design quantities will be adjusted if the Engineer makes changes to adjust to field conditions, if plan errors are proven or if design changes are necessary.

501.7.2 Vehicular Measurement. Aggregate surface course will be measured by the cubic yard in approved vehicles at the point of delivery. Water required for mixing and operations will be considered as incidental to the surface course.

501.8 BASIS OF PAYMENT. The accepted quantity of aggregate surface course will be paid for at the respective contract unit prices per cubic yard.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
501(1)	Aggregate Surface Course (Net Section)	Cubic Yard
501(2)	Aggregate Surface Course (Vehicular Measurement)	Cubic Yard

SECTION 502

TACK COAT

502.1 DESCRIPTION. This work consists of preparing and treating an existing asphaltic or concrete surface with asphaltic material in accordance with these specifications and is reasonably close conformity with the lines shown on the plans or established by the engineer.

502.2 ASPHALTIC MATERIAL. The tack coat shall be cutback asphalt, Grade RC-70 or C-250, or emulsified asphalt, Grade SS-lh or SS-I and shall conform to Section 204.

502.3 PREPARATION OF SURFACE. The existing surface shall be cleaned by sweeping or by other approved methods. Edges of existing pavements adjacent to new pavement shall be cleaned to permit adhesion of the asphalt.

502.4 APPLICATION OF ASPHALT. The asphalt shall be uniformly applied with a pressure distributor at a rate not to exceed 0.05 gallon per square yard (.228 l/sq. m). The tack coat shall not be applied on a wet surface or when the temperature is below 40 degrees F (4 degrees C). The rate of application, temperature of the asphalt and areas to be treated shall be approved prior to application. The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic.

502.5 METHOD OF MEASUREMENT. When a pay item for tack coat is included in the contract, the tack coat placed and accepted will be measured in the distributor by the gallon of 231 cubic inches.

502.6 BASIS OF PAYMENT. When a pay item for tack coat is included in the contract, the accepted quantity of tack coat will be paid for at the contract unit price per gallon. When the contract does not contain a pay item for tack coat, the required work will not be paid for directly, but will be considered as a subsidiary obligation of the contractor under other contract items.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
502 (I)	Tack Coat	Gallon

SECTION 503

PRIME COAT

503.1 DESCRIPTION. This work consists of treating a prepared or existing surface with asphalt in accordance with these specifications and in reasonably close conformity with lines shown on the plans or established by the engineer.

503.2 ASPHALT MATERIAL. The asphalt used as a prime coat shall be Grade MC-30 or Grade MC-70 cutback asphalt, as directed. Cutback asphalt used as a prime coat shall conform to Section 204.

503.3 WEATHER LIMITATIONS. Asphaltic materials shall not be applied on a wet base nor when the temperature of the air is less than 60 degrees F (18 degrees C) in the shade.

503.4 PREPARATION OF SURFACE. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material or other irregularities and shall be compacted to the required density. Delays in priming will necessitate reprocessing or reshaping to provide a smooth compacted surface.

503.5 APPLICATION OF ASPHALT. The primer shall be applied to the prepared base and shall extend 6 inches (15.24 cm) beyond the width of surfacing shown on the plans. The prime coat shall not be applied until the base has been properly swept and is firm, compact, and dry. The method of application shall be the same as provided under Subsection 503.3. If the course is to be constructed on an existing pavement, the pavement shall be primed if so indicated on the plans or directed.

When the prepared base consists of cement or l.m. treated or stabilized material and where the protective coating or emulsified asphalt has become worn or is otherwise insufficient, the contractor will be required to spot-prime the base course as directed or the prime coat may be reduced or deleted.

The prime coat shall be maintained intact and if required, the primed surface shall be thoroughly cleaned prior to the application of the wearing surface. Where the prime coat has failed or depressions have occurred, the failure shall be swept clean, brush-coated with cutback asphalt and refilled with a satisfactory asphaltic mixture. If the prime coat is generally unsatisfactory, the contractor shall be required to reprime the unsatisfactory surface. Rate of application for prime coat asphalt shall be a min. of .25 gal./sq. yd. (1.1 liter/sq. m) at 60 degrees F (18 degrees C).

503.6 PROTECTION. After the prime coat has been applied, unless it is impractical to detour highway traffic, the contractor shall keep all traffic off the road until the asphalt has properly cured. In cases where traffic is permitted, the contractor may be required, at his expense, to spread the minimum necessary amount of granular material approved by the Project Engineer over the prime coat.

503.7 BASIS OF PAYMENT. The accepted quantities of prime coat will be paid for at the contract unit price per gallon complete in place, except as follows. When the contract does not contain a pay item for prime coat, the required work will not be paid for directly, but will be considered as a subsidiary obligation of the contractor under other contract items. Payment will be made under:

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
503 (1)	Prime Coat	Gallon

SECTION 504

ASPHALTIC SURFACE TREATMENT

504.1 DESCRIPTION. This work consists of furnishing and constructing a wearing surface of mineral aggregate and asphalt on a prepared base course or on an existing pavement, in accordance with these specifications and in reasonably close conformity with the lines, grades and typical cross sections shown on the plans or established by the engineer.

Asphaltic surface treatment shall consist of the number of applications of each of the specified sizes of mineral aggregate and the specified asphalt.

504.2 ASPHALT MATERIAL. The asphalt shall be asphalt cement, Grade AC-5 or AC-10, conforming to Section 204.1.

504.3 AGGREGATES. Aggregates shall be uncrushed gravel, or crushed gravel, crushed slag or crushed stone, and shall conform to Subsection 200.5.

504.4 WEATHER LIMITATIONS. Asphalt shall not be applied on a wet base nor when the temperature of the air is less than 60 degree F (18 degrees C) in the shade.

Asphalt shall not be applied during the calendar months of November, December, January, and February, unless otherwise approved in writing by the Engineer. When approved, one of the following additional requirements shall be met during these referenced months.

(a) All aggregate to be spread shall be mechanically dried and placed in a surface dry condition. The project may then be accepted when all work is completed.

(b) If asphalt is placed during the above referenced months without mechanically drying aggregates the contractor shall be responsible for the project, and the final inspection will not be made until such time after March 1st equal to the time that was actually required to place the surface treatment.

504.5 EQUIPMENT. All equipment for the proper construction of this work shall be in good working condition and shall have been approved before construction begins. The equipment shall be maintained in a satisfactory working condition and shall be approved by the Engineer.

504.6 QUANTITIES OF MATERIAL. The quantities of materials per square yard, application temperatures and the sequence of application and spreading for the asphaltic surfacing as specified shall be as shown in Table I, unless otherwise directed. The quantities shown in Table I are approximate. The actual quantities used shall be as directed by the engineer.

Any aggregates spread in excess of 5% over the quantity specified by the engineer, per square yard, will not be considered for payment on a cubic yard basis.

504.7 APPLICATION OF ASPHALT. After the prime coat, when required, has been satisfactorily cured, asphalt and aggregate shall be applied in the amounts and in the sequence herein specified. The length of spread of the asphalt shall not exceed that which can be covered immediately with the aggregate material.

TABLE I
QUANTITIES OF MATERIAL PER SQUARE YARD

<u>Gal. of Asphalt at 60 deg. F (18 deg. C)</u>		<u>Cubic Yards of Aggregate</u>		
	Asphalt Cement	Size 1 - Course	Size 2 - Fine	Size 3 - Seal
First Application	0.4 (1.5 L)			
Spreading		.02 (.15 cu. m)		
Second Application	0.3 (1.1 L)			
Spreading			.0111 (.039 cu. m)	
Third Application	0.2 (.74 L)			
Spreading				.0075 (.028 cu. m)
TOTALS	0.9 (3.4 L)	.02 (.15 cu. m)	.0111 (.039 cu. m)	.0075 (.028 cu. m)

Asphalt for each application shall be applied uniformly for the full width of the treatment unless, due to the impracticability of detouring highway traffic, the engineer directs that the material to be applied to ½ of the roadway at one time. If the contractor is unable to keep the application of asphalt consistently within 5% of the quantity specified, he shall discontinue operations until he can provide an operator of greater experience or a better distributor, or both, or shall provide such precautions as may be necessary to keep the application within the available variations. The distributor shall be operated along a marked edge in order to keep the surface treatment in a straight line.

In order to secure uniform distribution at the junction of 2 applications, the distributor shall be promptly stopped when the uniform flow decreases, indicating the tank is nearly empty. Building paper shall be placed over the end of the previous application, and the joining applications shall start on the building paper.

During the application of asphalt, care shall be taken to prevent spattering adjacent pavements, structures and trees. The distributor shall not be cleaned or discharged into ditches, borrow pits, on the shoulders or along the right-of-way.

The contractor is cautioned to exercise care in heating asphalt to temperatures above flash points for the various types of asphalt.

504.8 SPREADING COVER MATERIAL. The aggregate material shall be uniformly spread over the full width of asphalt material with one or more passes of spreading equipment with the application being sharply defined at the edges. The equipment shall not be driven on the uncovered asphalt. If necessary to obtain uniform coverage, the surface shall be dragged or broomed.

Hand spreading by experienced workmen will be permitted in conjunction with the self-propelled spreaders over areas inaccessible to the spreaders.

504.9 ROLLING COVER MATERIAL. Immediately after spreading and brooming or dragging the cover material, the entire surface shall be rolled with a power roller. Rolling shall proceed in a longitudinal direction beginning at the outer edges of the treatment, and progressing toward the center, each trip overlapping the prior trip about ½ the width of the roller. The first rolling shall be completed within ½ hour after the cover material has been spread. During

rolling, the previously spread cover material shall be uniformly broomed or dragged and placed where necessary in such quantity as to completely cover the asphalt surface. Rolling, dragging or brooming and spotting of additional cover material shall be continued until uniform coverage has been obtained. The remaining courses shall be rolled the same as specified for the first course and shall not be placed until the previous course is surface dry.

504.10 PROTECTION. Traffic shall not be allowed to use the road, unless otherwise provided, until the final application has been placed and thoroughly rolled.

After the application of the cover coat material, the surface where directed shall be lightly broomed or otherwise maintained for a period of 4 days or as directed. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free asphalt, covering any area deficient in cover coat material, and an additional rolling as directed by the engineer at no additional cost to the City. The maintenance shall be conducted so as not to displace imbedded material.

Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by the engineer.

504.11 METHOD OF MEASUREMENT.

- (a) The quantities of aggregate and asphalt incorporated in the completed and accepted asphaltic surface treatment will be measured separately. Aggregate will be measured by the cubic yard and asphalt will be measured by the gallon.
- (b) The asphaltic surface treatment complete and accepted will be measured by the square yard of each type of surface treatment incorporated into the project.

504.12 BASIS OF PAYMENT. The accepted quantities of asphalt, aggregates and asphaltic surface treatment will be paid for at the contract unit prices.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
504(1)	Asphalt	Gallon
504(2)	Coarse Aggregate (Size 1)	Cubic Yard
504(3)	Fine Aggregate (Size 2)	Cubic Yard
504(4)	Seal C at Aggregate (Size 3)	Cubic Yard
504(5)	Asphaltic Surface Treatment (1 application)	Square Yard
504(6)	Asphaltic Surface Treatment (2 applications)	Square Yard
504 7)	Asphaltic Surface Treatment (3 applications)	Square Yard

SECTION 505

ASPHALTIC CONCRETE FRICTION COURSE

505.1 DESCRIPTION. This work consists of furnishing and constructing a thin asphaltic concrete friction course on a prepared surface, in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the engineer.

505.2 MATERIALS. Materials, composition and quality control of mixture for asphaltic concrete friction course shall conform to Subsection 204.6.

505.3 WEATHER LIMITATIONS. Weather limitations shall be as prescribed in Section 507 with the following amendments. The placing of friction course shall be discontinued when the base temperature falls below 60 degrees F (18 degrees C) and shall not be resumed until the base temperature reaches 60 degrees F (18 degrees C). If friction course is placed during the months of November, December, January, and February, final acceptance of the project will not be made until after the following May 1st and the contractor will be required to satisfactorily maintain the friction course until final acceptance is made.

505.4 CONDITIONING OF EXISTING SURFACES. The surface to be covered shall be swept clean and free from dust and dirt, caked clay and loose foreign material by means of revolving brooms or other approved mechanical sweepers supplemented by hand brooms. Contractor shall remove excess joint filler from existing surfaces by burning as approved by Engineer. Contact surfaces of curbs, gutters, manholes, longitudinal joints and other structures shall be painted with a thin uniform tack coat prior to placement of asphaltic mixture. The condition of the base shall be approved by the Engineer prior to placing asphaltic material.

505.5 TACK COAT. Tack coat conforming to Section 502 shall be uniformly applied at the rate specified by the engineer, but not to exceed 0.1 gallon per square yard. The contractor will be responsible for protection of the tack coat prior to placement of friction course, and any retacking required shall be done at no extra cost. Unless a pay item for tack coat is provided for in the contract, tack coat will not be paid for directly but will be considered incidental to the asphaltic concrete friction course item.

505.6 PREPARATION OF ASPHALT AND AGGREGATES. Aggregates shall be dried and heated to the required temperature. Burners used for drying shall be properly adjusted to avoid contamination with soot or oil. Aggregates thus contaminated will be rejected. Aggregates shall be mixed with asphalt cement to produce a mixture that does not exceed 280 degrees F (138 degrees C). During cool weather, this temperature may be increased to 300 degrees F (149 degrees C) to allow for proper compaction. Mixing of asphalt and aggregates shall continue until aggregates are thoroughly coated with asphalt. Suitable locking means shall be provided for regulations of mixing time.

505.7 HAULING, SPREADING AND FINISHING. Spreading and finishing shall be as prescribed in Section 507 with the following amendments:

The temperature of the mixture at the time of placement on the surface shall be not less than 200 degrees F (93 degrees C). The friction course shall be transported and placed with a minimum of separation of asphalt and aggregates. The spreading and finishing machines, equipped with approved automatic screed and slope control devices, shall work with the 30-foot (91 m) traveling string-line.

Longitudinal joints shall be at the center line of the pavement if the roadway comprises two lanes of width, or at lane lines if the roadway is more than two lanes. Transverse joints shall be in accordance with Section 507.

505.8 COMPACTION. Immediately after placement, friction course shall be uniformly compacted to the satisfaction of the engineer with a tandem steel-wheel roller of such weight as to accomplish acceptable density without excessive breakage of the aggregate.

505.9 PROTECTION OF PAVEMENT. Sections of newly finished friction course shall be protected from traffic until it has sufficiently hardened.

505.10 SURFACE TOLERANCES. Due to the composition and nature of friction course, no fixed surface tolerances will be established; however, the mixture shall be placed by approved methods that will provide uniform thickness of the friction course layer.

505.11 METHOD OF MEASUREMENT. The quantities for payment will be the design quantities specified in the plans and adjustments thereto. The design of asphaltic concrete friction course is based on the horizontal dimensions shown on the plans. Unless otherwise provided, all tack coat required will not be measured for separate payment, but will be considered incidental to the asphaltic concrete friction course pay item.

505.12 BASIS OF PAYMENT. The accepted quantity of asphaltic concrete friction course will be paid for at the contract unit price per square yard. Payment will be made under:

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
505 (1)	Asphaltic Concrete Friction Course	Square Yard

SECTION 506

SLURRY SEAL COAT SURFACING

506.1 DESCRIPTION. Slurry seal coat surfacing shall consist of emulsified asphalt, water and mineral aggregates proportioned, properly machine mixed and spread uniformly by machine, supplemented by hand spreading, applied over surfaces shown on the plans or directed by the Engineer, in accordance with these specifications. It includes furnishing material, hauling, mixing, placing, spreading, and protecting.

506.2 MATERIALS. Materials, testing and proportioning of mixture for bituminous slurry seal coat shall conform to Subsection 204.7.

506.3 EQUIPMENT. Equipment, tools and machines used in the performance of this work shall be approved by the Engineer and maintained in satisfactory working condition.

506.4 PREPARATION OF OLD SURFACE. The surface shall be swept clean of all dust, dirt, or other objectionable material. Badly cracked areas shall be thoroughly wetted prior to application of the slurry seal in order to facilitate proper penetration into the cracks of the old surfacing. If the old surfacing is badly oxidized and the asphalt looks dead and brown, use of a very light application of emulsified asphalt fog coat shall be used. The rate of application shall not exceed 00.03 gallons per square yard.

506.5 APPLICATION OF SLURRY SEAL COAT. The application of bituminous slurry seal coat shall be made by means of a spreader box, hand squeegees, or other specialized equipment that may be developed by the Contractor. The spreading equipment shall be towed at a constant speed and the slurry mixture discharged by means of a chute direct from the mixer into the spreading equipment. The rubber squeegees of the spreading equipment shall be adjusted so as to apply a uniformly level course of slurry seal mixture in a thickness of not less than 1/8-inch (3.17 mm) to not more than 1/4-inch (6.35 mm) thick. The trailing flexible squeegee shall be kept sufficiently wet to provide an even slurry surface free from lap-marks. The flexible squeegee shall be kept cleaned or renewed to remove hardened slurry materials. In areas where the spreading equipment cannot be used, the slurry mixture may be applied by means of hand squeegees. Any joints or cracks that do not remain completely filled with the slurry mixture applied by the spreader box, or that develop contraction cracks, shall be corrected by means of hand squeegees. Upon completion of the work, the bituminous slurry seal coat shall be free of voids and cracks.

506.6 WEATHER LIMITATIONS. Bituminous slurry seal coat shall not be applied when the atmospheric temperature is below 60 degrees F (15 degrees C).

506.7 CURING AND FINISHING. After application, the fresh seal shall be protected by barricades and markers and permitted to dry a minimum time of 4 hours or more when the weather conditions and thickness of application of the slurry seal required additional drying time. Also prior to the placement of the slurry, the contractor shall be responsible for the installation and maintenance of barricades at all streets and avenues of access to insure that no traffic will enter on the newly sealed streets until the slurry has had ample time to cure. Any damage to the seal coat due to traffic before the slurry has cured will be repaired at the Contractor's expense. The barricades will not be removed or the street opened to traffic until approval is given by the Engineer.

506.8 METHOD OF MEASUREMENT. Bituminous slurry seal application shall be measured by the square

yard, mineral aggregate shall be measured by the cubic yard, truck measure, at the point of delivery on the road. Emulsified Asphalt shall be measured by the gallon, in the distributor, at 60 degrees F. When provided in the Contract Proposal, bituminous slurry seal shall be measured by the square yard complete in place.

506.9 BASIS OF PAYMENT. The number of square yards of surface to which the slurry seal is applied as measured above shall be paid for under the contract unit price per square yard of Slurry Seal Coat Application. Payment shall constitute full compensation for the uniform application of the slurry and shall include the furnishing all equipment, tools, labor, and incidentals required and the performance of all work necessary to complete the items.

The number of cubic yards of mineral aggregate measured as provided above shall be paid for at the contract unit price per cubic yard of mineral aggregate. Payment shall constitute full compensation for the material delivered to designated points on the project and shall include the furnishing of all equipment, tools, and labor required to furnish the items.

The number of gallons of emulsified asphalt measured as provided above shall be paid for at the contract unit price per gallon of emulsified asphalt. Payment shall constitute full compensation for the material furnishing and shall include the furnishing of all equipment, tools, and labor required to furnish the item and temporarily store the material.

If provided in the Construction Proposal, the number of square yards of slurry seal coat, complete in place, measured as provided above shall be paid for under the contract price for Slurry Seal Coat, complete. Payment shall constitute full compensation for the seal coat application and shall include furnishing all materials, equipment, labor, and incidentals required to complete the item of work.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
506 (1)	Slurry Seal Coat Application	Per Square Yard
506 (2)	Mineral Aggregate	Per Cubic Yard
506 (3)	Emulsified Asphalt	Per Gallon
506 (4)	Slurry Seal Coat Complete	Per Square Yard

SECTION 507

ASPHALTIC CONCRETE PAVEMENT

507.1 DESCRIPTION. This work shall consist of a base course, binder course and a wearing course, or a combination of these courses, each consisting of a mixture of mineral aggregate and bituminous material applied hot on a prepared subgrade in conformity with the line, grade and thickness indicated on the Drawings in accordance with these specifications. Work includes furnishing transporting, placing, spreading, compacting, protection and includes the prime or tack coats.

507.2 MATERIALS. Materials, composition, proportioning of mixtures shall be as specified in Subsection 204.5.

507.3 HAULING EQUIPMENT. Vehicles used for the transportation of asphaltic mixtures shall have tight, clean, smooth metal beds. The vehicle beds shall be painted or sprayed at least once a day or as often as required with lime water, soap solution or an approved asphalt release agent. Each vehicle shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather. When job conditions necessitate, covers shall be securely fastened.

The hauling unit shall discharge the mixture in a continuous manner so the spreader apron of the paver will not be overloaded. The truck bed shall not rest directly on the apron of spreader. Trucks that are to be pushed by paver shall be of such size and capacity that the paver will push them without affecting the surface smoothness or the edge line of the mixture. Any distortions in the surface finish resulting from improper unloading of the mixture shall be corrected immediately.

507.4 PAVING EQUIPMENT. Pavers shall be the conventional self-powered pavers, or pavers equipped with automatic screed and slope control devices for use with a minimum 30-foot (9.1 m) traveling stringline or with an erected stringline. The project specifications will state the type or types of paver controls required for the project. If paver controls are not specified in the project specifications, paver controls will be as directed by the Engineer.

507.4.1 Conventional Pavers. Pavers shall be capable of laying mixtures within the tolerances specified. A screed or strike-off assembly shall be used, distributing the mixture either over the entire width or over such partial lane widths as may be practicable. The assembly shall be adjustable to give the cross section shape as indicated on the plan typical sections. The screed shall be equipped with a heater.

Pavers shall be equipped with hoppers and distributing screws to place the mix evenly in front of an adjustable screed. They shall be equipped with a quick and efficient steering device and shall be capable of traveling both forward and in reverse. Pavers shall be capable of spreading mixes to required thickness without segregation or tearing. Unless otherwise specified, when leveling is required by the plans, a blade grader may be used when approval is given by the Engineer. In shoulder construction, modified conventional spreaders or widener spreaders shall be provided.

507.4.2 Pavers With Automatic Speed Control. This type paver shall meet the same requirements as described above for conventional pavers and shall be equipped with automatic screed and slope control devices capable of laying the mixture to grade within the tolerances specified, distributing the mixture over the entire width or over such partial lane widths as may be practicable. Pavers shall be equipped with two sensors when required. The pavers shall be equipped to work from an erected stringline or a traveling stringline that will accurately reflect, for a minimum

30-foot (9.1 m) length, the average grade of the surface on which it is to be operated. Pavers shall also be equipped with a shoe attachment to control the grade of a lane being placed adjacent to a previously placed lane.

507.5 ROLLERS. Rollers shall be self-propelled and shall be in good condition, capable of reversing without backlash. The number and weight of the rollers shall be sufficient to compact the mixture to the required density and surface smoothness while it is still in workable condition and shall be capable of maintaining the pace of the paver.

The use of equipment which results in crushing of the aggregate will not be permitted. Vibratory rollers with separate controls for energy and propulsion and especially designed for asphaltic concrete compaction may be used provided the vibratory rollers do not impair the stability of the pavement structure and any underlying layers. In shoulder construction, modified conventional spreaders or widener spreaders shall be provided.

507.6 INCIDENTAL EQUIPMENT AND HAND TOOLS. Power revolving brooms or power lowers and distributors shall be provided and maintained in a satisfactory working condition. Tamping tools used to consolidate the edges of the binder and wearing courses shall be sufficient weight to compact the edges to the same degree as the body of the pavement. Satisfactory mechanical equipment may be used instead of tamping tools.

The distributor shall be equipped with suitable manifold and appliance so designed as to distribute evenly heated material within the temperature range specified with positive controlled heat and temperature at all times, and shall be equipped with thermometers to indicate the temperature of the material in the tank. The distributor shall be so designed as to maintain a constant and uniform pressure upon the asphaltic material as it passes through the nozzles.

The distributor shall be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of asphaltic materials being applied per square yard of surface under the operating conditions, and shall have a tachometer, reading speeds in feet per minute. The distributor shall be so designed as to apply asphaltic material at the specified rate.

507.7 HANDLING AND PROCESSING OF AGGREGATES. Coarse and fine aggregates shall be stored at the plant site in such a manner that the separate sizes will not become intermixed. When stockpiling, the material shall be placed to minimize segregation of aggregate sizes. Blending of aggregates in stockpiles or on the ground at the plant site or at the source will not be permitted. The gradation for the individual stockpiles and proportioning from these stockpiles will be the contractor's responsibility. The gradation of the aggregate in the stockpiles shall be such that when the aggregates are combined in the proper proportions, the resulting combined gradation will meet the requirements of the job mix formula. The proportioning of the material at the cold feed will be established by the contractor to meet the job mix gradation requirements. This will be done in such a manner that when plants operate with only cold feed control further manipulation will not be necessary to meet job mix requirements.

507.7.1 Drying. For all plants the aggregate shall be heated and dried to produce a paving mixture meeting the requirements of the specifications. The quantity of material fed through the dryer shall be held to an amount which can be adequately heated and dried. If proper drying is not achieved and the quality of the mix is impaired, the contractor shall adjust the rate of production of the dryer, as required to obtain satisfactory results.

507.7.2 When Screens Are Used. Aggregates shall be screened into sizes such that they may be combined into a gradation meeting the requirements of the job mix formula.

507.8 PROCESSING OF ASPHALT AND AGGREGATES. The aggregates shall be combined, either prior

to or after drying, depending on the type of plant used, to meet the job mix formula. The asphalt shall be measured and introduced into the mixer or the dryer in the quantities specified in the job mix formula.

In case of conventional plants with pugmills, Prior to adding asphalt cement, the combined mineral aggregate shall be thoroughly mixed dry, after which the proper amount of asphalt shall be sprayed over the mineral aggregate and mixed to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated. The mixing time shall be submitted by the contractor in the job mix formula and approved by the Engineer.

In case of dryer-drum plants, the aggregate and asphalt shall be fed into the dryer-drum in such a manner that the aggregates are adequately coated with asphalt.

The aggregate, asphalt and the mixture will be processed at the temperature specified in the job mix formula. The temperature of the mixture at discharge from the mixer shall be within ± 25 degrees F (± 13 degrees C) of the temperature approved in the job mix formula provided the mixing, coating, placing and density requirements are met.

In case of dryer-drum plants, the moisture content of mixture shall be minimized and uniformly controlled in order to insure that placing and density requirements are met. The contractor's technician will be required to measure the moisture content of aggregate when starting the plant and adequate scheduled tests during plant operations and adjustments to plant shall be made accordingly. The Engineer shall approve the schedule for moisture content testing. When dryer-drum plants are used, approved means shall be provided to divert and waste the first and the last output of the plant after each interruption that results in a change in mix quality.

507.9 WEATHER LIMITATIONS. Asphaltic concrete mix shall not be applied on a wet surface, except that material in transit at the time the plant operation is discontinued may be laid, subject to the end product meeting specifications. Placement of the mixture shall be discontinued when the descending air temperature in the shade and away from artificial heat reaches 45 degrees F (8 degrees C) and shall not be resumed until the ascending temperature reaches 40 degrees F (5 degrees C). If the work consists of placing material in lift thicknesses greater than 3 inches, (7.8 cm) these temperature limitations shall not apply provided all other requirements of the specifications are met.

507.10 CONDITIONING OF EXISTING SURFACE. The surface to be covered shall be swept clean and free from dust and dirt, caked clay and loose foreign material by means of revolving brooms or other approved mechanical sweepers supplemented by hand brooms, as directed. When the mixture is to be placed on an existing pavement, the contractor shall, in addition to cleaning the surface as required above, remove excess joint filler from the surface by an approved burning method. This does not relieve the contractor from maintaining the existing pavement at his expense. Contact surfaces of curbs, gutters, manholes, longitudinal joints and other structures shall be painted with a thin uniform coating of tack coat before the asphaltic mixture is placed against them. The condition of the base shall be approved prior to the placing of the mixture.

507.11 JOINTS. The longitudinal joints in one layer shall offset that in the layer immediately below by approximately 3 inches (7-8 cm), however, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises 2 lanes of width, or at lane lines if the roadway is more than 2 lanes. Transverse joints shall be butt joints formed by cutting back on the previous run to expose the full depth of the course. Transverse joints in succeeding courses shall be offset at least 2 feet (.61 m). When directed, a brush coat of asphaltic material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

507.12 TACK AND PRIME COAT. Before constructing each course, a tack coat of the width indicated on the plans shall be applied if needed at the rate specified by the Engineer in accordance with Section 502. The responsibility for the protection of the tack coat shall rest with the contractor, and required spot-patching shall be made at no extra cost.

Asphaltic concrete shall not be applied on a tacked surface or primed base until the asphaltic material has cured to the satisfaction of the Engineer. If asphaltic concrete is to be placed on an aggregate type base course, the contractor shall use a prime coat as described in Section 503 in lieu of the tack coat required herein. If the primer has dried out or is otherwise insufficient prior to laying the asphaltic concrete, the contractor shall, at his expense, re-prime the base or apply a light tack coat as directed; however, the primed surface shall be completely cured to the satisfaction of the Engineer. Unless pay items for tack coat and prime coat are provided for in the contract, these items will not be paid for directly but will be considered incidental to the bid items.

507.13 SPREADING AND FINISHING. The mixture shall be transported from the mixing plant and delivered at the site of work at a temperature no cooler than 25 degrees F (14 degrees C) below the minimum allowable temperature of the mixture when discharged from the mixer. The temperature of the mix going through the paver shall not be cooler than 250°F (120°C). No loads shall be sent out so late in the day as to prevent completion of the spreading and compaction of the mixture during daylight, unless artificial light is approved by the Engineer.

The laying operations shall be conducted in the following manner:

507.13.1 Coordination of Production: The contractor shall coordinate and manage the plant production, the transportation of the mix and the laying operation to achieve a high quality pavement. He shall have sufficient hauling vehicles to insure more or less continuous plant and roadway operation with a minimum idle time between loads.

When the adjacent travel lane is not paved the next calendar day and the longitudinal joint is exposed to traffic for more than three calendar days, the entire length of exposed longitudinal joint shall be cut back to plan thickness to a vertical edge and heavily tacked.

The City reserves the right to order a halt to operations if sufficient hauling vehicles are not available. If less than the optimum number of hauling vehicles are available and it is determined that satisfactory quality can be obtained, the contractor will be permitted to work provided the plant production and the hauling vehicles are coordinated to minimize the effect of idle time between loads.

507.13.2 Pavers. The pavers used shall be one of the types described in Subsection 507.4 as specified by the project specifications or as directed by the Engineer. If the spreading and finishing operation is interrupted to such extent that some of the mixture remaining in the trucks, spreader, spreader hopper or on the roadway cools to where it cannot be laid, finished or compacted to the same degree of smoothness and with the same texture and density as the uncooled mixture, the cooled mixture shall be removed and replaced at the contractor's expense.

The following requirements shall apply for mechanical spreaders with automatic screed control:

507.13.2.1 Automatic Screed Control with Minimum 30-foot Traveling Stringline: The initial lane of each course to be laid, whether it be wearing, leveling, base, binder, or a combination of any of these courses, shall be constructed in the approximate lifts shown on the plans using the traveling stringline method; however, if field conditions warrant, the portion of the leveling course required to level isolated depressions may be placed without the

automatic screed control device. If field conditions warrant, the traveling stringline may be used to control the grade of any adjacent lane on all courses with the exception of the final wearing course.

In cases where both of the outside edges of the lane being placed are flush with previously placed material, the slope device shall not be used. A grade sensor may be required for each side of the spreader. When three or more contiguous lanes are to be constructed, the order of construction shall be as directed. The courses placed in lanes which are not adjacent to a lane previously placed with the traveling stringline shall be constructed using the traveling stringline. In superelevated curves, the cross slope shall be changed from that specified for tangents to that specified for superelevation in gradual increments as the paver is in motion so that smooth transition in grade is obtained. This change in cross slope shall be accomplished within the transition distance specified.

507.13.2.2 Automatic Screed Control with Erected Stringline: The initial lane of the first course to be laid, whether it be leveling, base, binder or a combination of any of the three, shall be controlled by an erected stringline referenced to grade stakes established by the Engineer; however, if field conditions warrant, the portion of the leveling course required to level depressions may be placed without the automatic screed control device.

The paver shall be positioned and operated to closely follow the established line. Only one sensor and the slope control device is necessary for normal crown on tangents. Superelevated curves will require the use of two sensors and two erected stringlines to obtain proper grade and slope; however, if the automatic screed control device furnished by the contractor is equipped with a dial or other device which can be conveniently used to change the cross slope in small increments, superelevated curves may be constructed using this device and one erected stringline.

After the initial lane of the first course is finished and compacted, the adjacent lane or lanes on the first course will be laid to the grade of the initial lane, using a grade sensor to control grade and controlling the cross slope with the slope control device. If field conditions warrant, the traveling stringline may be used to control the grade of any adjacent lane on all courses with the exception of the final wearing course unless otherwise directed by the Engineer.

In cases where both of the outside edges of the lane being placed are flush with previously placed material, the slope device will not be used. A grade sensor may be required for each side of the spreader. In cases where only one course is to be constructed in one lift, the first lane laid will be controlled by use of an erected stringline referenced to grade as directed above unless otherwise directed. The adjacent lane or lanes will be controlled as described above. When three or more continuous lanes are to be constructed, the order of construction shall be as directed, and subsequent first course lanes which are not adjacent to a previously placed initial lane shall be considered an initial lane.

Transfer of the asphaltic mixture from the haul truck to the spreader may be made by direct unloading into the spreader hopper by use of approved mechanical loading devices or by direct dumping on the roadbed. When the mixture is dumped directly on the roadbed, approved loading equipment will be used to transfer the mixture into the finishing machine, and the equipment shall be constructed and operated in such a manner that substantially all of the mixture deposited on the roadbed is picked up without contamination by foreign material.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operations or which produces flushing or other permanent blemishes, or fails to produce a satisfactory surface shall not be used.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity. The adjustment of the screed, tamping bars, feed screws, hopper feed, etc., shall be checked frequently to assure uniform spreading of the mix to the proper line and grade and adequate initial compaction. Segregation of

materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected.

Any irregularities in alignment left by the paver shall be corrected by trimming directly behind the machine. Immediately after trimming, the edge of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided. Edges against which additional material is to be placed shall be reasonably formed to lines and approximately vertical. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed. Indented areas shall be filled with hot mix and finished reasonably smooth. Casting of material over the surface will not be permitted whenever wearing course is being laid. The outside edge of the freshly laid mixture shall be tamped, behind the spreader prior to rolling, to reasonably vertical edge wherever base or binder courses are being laid, and to approximately 45 degrees beveled edge when the wearing courses are being laid.

507.13.3 Hand Spreading: In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand. Approved wood or steel forms, rigidly supported to assure reasonably correct grade and cross section, may be used. In such instances, measuring blocks and intermediate strips shall be used to aid in obtaining the required cross section. During the spreading operation, all material shall be thoroughly loosened and uniformly distributed. Material that has formed into lumps and does not break down readily will be rejected. Following placing and before rolling, the surface shall be checked and all irregularities corrected.

507.14 COMPACTION. After spreading and striking off and while still hot, each course shall be thoroughly and uniformly compacted by rolling. The highest contact pressure that will give the required density shall be used for any pneumatic roller.

Pneumatic-tire roller shall be kept approximately 6 inches (15.2 cm) from the unsupported centerline joint when only one lane is in place. However, when both lanes are down, it shall be overlapped at least 6 inches (15.2 cm) to get additional sealing of the joint. Rolling shall be conducted in such sequence and by methods that will obtain the specified density and smoothness requirements. Each roller shall be operated by a competent, experienced operator and, while the work is under way, shall be kept as nearly as practical in continuous operation.

The motion of the roller at all times shall be slow enough to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller or from any other cause shall be immediately corrected. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened when needed, but excess water will not be permitted. Rolling shall continue until all roller marks have been eliminated.

Along forms, curbs, headers and walls and at other places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers or mechanical tampers to obtain a satisfactory density. The surface of the mixture after compaction shall be smooth and true to the established cross slope and grade. Any mixture that becomes loose, broken, contaminated or in any way defective shall be removed and replaced with fresh hot mixture which shall be immediately compacted to conform with the surrounding area.

507.15 PROTECTION OF PAVEMENT. Sections of newly finished pavement shall be protected from traffic until the pavement has sufficiently hardened.

507.16 METHOD OF MEASUREMENT. Measurements will be made by one of the following methods as indicated. Unless otherwise provided, tack coat or prime coat required will not be measured for separate payment but

will be considered incidental to the asphaltic concrete pay item.

507.16.1 Weight Measurements: Aggregates inclusive of mineral filler, and asphalt will be measured by the ton of 2,000 pounds. (.92 metric T). When the mixture is produced in (1) a continuous mixing plant, (2) a dryer-drum mixing plant, (3) when mixture is supplied from storage silos and surge bins or (4) batch plant, measurement will be determined from the printed weights as provided in Subsection 204.5. Stamped printer tickets will be issued for each truck load of material delivered. Material lost, wasted, rejected or applied contrary to these specifications will not be measured for payment.

507.16.2 Volume or Area Measurement. The quantities for payment will be the design quantities specified in the plans. Design quantities will be adjusted if the Engineer makes changes to adjust to field conditions, if plan errors are proven or if design changes are necessary. Design quantities are based on the horizontal dimensions and compacted thickness of the completed course shown on the plans. Shoulders, when shown on the plans to be separate from the roadway, will be measured by the cubic yard (net section) from dimensions shown on the plans.

507.16.3 Pavement Samples. Samples shall be cores approximately 4 or 6 inches (100 mm or 150 mm) in diameter taken by an approved core drill. The contractor shall furnish samples cut from the completed work. The removed pavement shall be replaced with hot or cold mixture and refinished during the work day coring is performed. No additional compensation will be allowed for furnishing test samples and replacing the areas with new pavement. Samples shall be taken by the contractor in the presence of the engineer's representative from areas selected by the City.

Cores less than 1 3/8 inches (35 mm) thick shall not be used as pavement samples for payment determination. Cores shall be transported to the plant in approved Styrofoam transport containers or one-gallon (4 L) friction-top cans. Regardless of transport container used, the container will be sealed, signed, and dated by the inspector using an approved method. The individually wrapped core will also be sealed, signed, and dated by the inspector using an approved method. Any evidence of tampering with the core wrappings, sticker, or of opening the container or friction-top can will result in the cores being rejected. Additional pavement samples will be required.

507.17 BASIS OF PAYMENT. The accepted quantities of compacted asphaltic concrete will be paid for at the contract unit price per unit of measurement.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
507(1)	Asphaltic Concrete	Ton
507(2)	Asphaltic Concrete	Cubic Yard
507(3)	Asphaltic Concrete	SquareYard(_____" Thick)
507(4)	Cold Planing	Square Yard/Inches

SECTION 508

COLD PLANING ASPHALTIC PAVEMENT

508.1 DESCRIPTION. This work consists of removing asphaltic concrete surfacing in accordance with these specifications and in conformity with the average depth, width, grade, cross-slope and typical sections shown on the plans or established.

508.2 EQUIPMENT. Equipment for cold planing asphaltic surfacing shall be an approved, self-propelled planing machine or grinder. They shall have sufficient power, traction and stability to remove the thickness of asphaltic concrete necessary to provide profile grade and cross slope uniformly across the surface. Cold planing equipment shall be capable of working from an erected stringline, shoe device or approved traveling reference plane that will accurately reflect, the average grade of the surface on which it is to be operated and shall have an automatic system for controlling cross slope at a given rate.

Adequate loading equipment shall be provided to immediately remove materials cut from the surface and discharge the cuttings into a truck or on the shoulder as specified or directed. When cuttings are placed directly on the shoulder or used in asphaltic concrete, surfacing with lightweight aggregate shall be removed separately. Adequate personnel shall be provided to ensure that the cuttings are removed from the surface daily. The drum shall be round and true with sufficient number of teeth to yield a uniform and fine textured surface for bonding of the subsequent overlay. The machine shall be equipped with means to control dust created by the cutting action and shall have a system providing for uniformly varying the depth of cut while the machine is in motion.

508.3 CONSTRUCTION REQUIREMENTS.

General: The maximum forward speed of the planing machine shall be 40 feet (12.0 m) per minute. The engineer may approve forward speeds greater than 40 feet (12.0 m) per minute provided the planed surface is uniform and fine textured and conforms to the surface tolerance requirements for a binder course. This speed shall be reduced as directed to provide a planed surface of uniform and fine texture with the specified grade and cross slope. Ridges left in the surface due to missing teeth shall be corrected by additional passes. The maximum depth of cold planing shall be 2.982 inches (50 mm) per pass when traffic is being maintained. Teeth lost during planing shall be immediately replaced. The traveling reference plane will be used on the first pass of the cold planing machine. The shoe device may be used on adjacent passes. This is the minimum acceptable method and the contractor must meet or exceed current profilograph specifications for surface tolerance.

When the entire roadway width has not been planed to a flush surface by the end of a work period resulting in a vertical or near vertical longitudinal face exceeding 2 inches (50 mm) in height, this longitudinal face shall be sloped as directed. Transverse faces present at the end of a work period shall be beveled as directed. Provisions shall be made at drives and turnouts to maintain local traffic. Asphaltic concrete next to structures that cannot be removed by the planing machine shall be removed by other acceptable methods. Pavement surfaces resulting from planing operations shall be of uniform texture, grade and cross-slope and free from loose material.

Planed surfaces not meeting these requirements shall be replaned at no direct pay. No uneven, undulating surfaces will be accepted. The contractor shall provide drainage of planed areas by cutting through the shoulder to the ditch. The cold planing operation shall not precede the subsequent paving operation by more than 15 calendar days. This time may

be extended if extensive joint repairs or patching is required. For single lift overlays requiring shoulder stabilization, the cold planing operation shall not precede the subsequent paving operation by more than 30 days.

On roadways that are open to traffic, pavement striping removed by planing shall be replaced with temporary pavement markings at the end of each day's planing operations. The reclaimed asphaltic pavement material (RAP) generated by the project shall remain the property of the City and shall be hauled to the City of Shreveport Maintenance Facility on Mansfield Road or other storage facility indicated on the plans and stockpiled by the contractor as directed at no direct pay. Required joint repairs shall be made after planing. Pavement patching shall be completed before planing. When additional areas requiring patching are exposed by planing operations, such additional patching shall be performed after planing. Pavement patching shall be in accordance with DOTD Section 724.

508.4 MEASUREMENT. Measurement will be made by the square yard per inch thickness (sq m) of asphaltic concrete surfacing satisfactorily removed.

508.5 PAYMENT. Payment of cold planing asphaltic pavement will be made at the contract unit price, which includes removal of asphaltic concrete surfacing and disposal of removed materials. Payment for temporary pavement markings will be included under appropriate pay items.

Payment will be made under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
508-1	Cold Planing Asphaltic Pavement	Square Yard/Inch

SECTION 509

PORTLAND CEMENT CONCRETE PAVEMENT

509.1 GENERAL. Unless otherwise specified, Portland cement concrete pavement shall be constructed of concrete prepared as prescribed in Subsection 201.1. The contractor will be permitted to furnish Class B, C, D or E concrete; however, the same type pavement mixture shall be used throughout the project unless otherwise authorized by the engineer in writing.

509.2 FORMS AND HEADERS.

509.2.1 General. Forms and headers shall be either wood or metal. They shall be set plumb and true to line and grade, with the upper edge thereof set to the grade of the pavement to be constructed; and shall be rigidly installed on a true alignment and so maintained for a distance in advance of placing the pavement to provide for at least a one-day run of concrete. Headers shall rest firmly on the subgrade or base. They shall be oiled immediately prior to the placing of the concrete and shall remain in place for at least 12 hours after concrete has been placed. Forms and headers must be removed before the work will be accepted.

At contractor's option, methods of forming and finishing concrete pavements may or may not be the same methods used for forming and finishing concrete curbs, gutters and walks. Construction of concrete curbs, gutters and walks shall be as specified in Section 605.

509.2.2.1 Metal Forms. Straight side forms shall be made of metal having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. On long curves (150 foot radius or longer), straight forms of shorter lengths will be permitted. Forms shall have a depth not less than the prescribed edge thickness of the pavement and a base width at least equal to the depth, except as otherwise approved by the engineer. Flexible or curved forms of property radius shall be used on curves 150 foot radius or less and shall be of a design acceptable to the Engineer. Forms shall be provided with adequate devices for secure setting. Flange braces shall extend outward on the base not less than 2/3 the height of the forms. Forms with battered top surfaces and bent, twisted or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved.

When acceptable, wooden forms shall be prescribed to the requirements as set forth by the specification listed below.

509.2.2.2 Wooden Forms. Wooden forms shall be constructed of 2-inch nominal lumber in pieces not less than 6 feet (4.9 m) long, except where changes in alignment or grade necessitate the use of material of smaller dimensions. The lumber used shall be free from warp and other imperfections which would impair the strength for the use intended; shall have square edges (which may be slightly beveled) and square ends; shall be surfaced on the upper edge; and shall not be more than 1/2 inch (12 mm) less in depth than the specified thickness of the edge of the pavement.

Such forms shall be secured by nailing to side stakes spaced not more than 4 feet (1.2 m) apart and driven into the subgrade vertically to a depth not less than 12 inches (305 mm), and so that the tops will be below the upper edge of the header. The stakes shall be of sufficient length and cross-sectional area to adequately resist lateral displacement of the headers during the paving operations.

Wooden headers shall be spliced by nailing a board to the outside of the headers. The board shall be at least 4 feet (1.2

m) long, 1 inch (25 mm) thick, and at least 6 inches (152 mm) wide (or the depth of the header, whichever is least), and shall be centered on the joint.

509.3 PLACING CONCRETE.

509.3.1 General. Concrete shall be placed on an approved subgrade sufficiently dampened to insure that no moisture will be absorbed from the fresh concrete. Immediately after being mixed, the concrete shall be deposited on the subgrade to the required depth over the entire width of the section.

At the end of each day's run, or at any time when operations are stopped for a period of more than 30 minutes, a rigid transverse header shall be placed vertically and at a right angle across the improvement at the location designated by the Engineer; and the pavement shall be finished to form a square, vertical joint against which the work may be resumed. Hand mixing may be used only if necessary to provide sufficient concrete to complete paving to the expedient header.

509.3.1.1 Grade Control. In the event of a split grade or other non-uniform cross section slopes of a pavement which deviate from the cross section slope as defined by the typical paving details, the following methods of concrete placement shall be used unless otherwise approved by the Engineer.

- (a) The contractor will be required to use electronic grade controls on both sides of the Slip Form Paver in accordance with all specifications required in the use of Slip Form Pavers.
- (b) Metal Forms. The contractor will be required to pour the first lane with Metal Forms in accordance with all specifications required for the use of Metal Forms.

509.3.2 Slip Form Construction. At the option of the contractor, and with the approval of the Engineer, concrete pavement may be constructed by the use of slip form paving equipment.

Slip form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape, and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section, and it shall spread, consolidate, screed, and float-finish the freshly placed concrete in such a manner as to provide a dense and homogenous pavement.

The concrete shall be distributed uniformly into final position by the slip form paver and the horizontal deviation in alignment of the edges shall not exceed 1/4 inch (6.3 mm) from the alignment established by the Engineer.

The concrete, for the full paving width, shall be effectively consolidated by internal vibration, with transverse vibrating units, or with a series of longitudinal vibrating units. Internal vibration shall mean vibration by means of vibrating units loaded within the specified thickness of pavement section and at a minimum distance ahead of the screed equal to the pavement thickness.

Concrete shall be given a preliminary finish by finishing devices incorporated in the slip form paving equipment. Final finishing for slip form pavement construction shall be as specified herein after.

509.3.3 Equipment. A list of all equipment used in the placement of concrete must be submitted to the Engineer prior to the commencement of construction. The Engineer will approve or disapprove the equipment requested by the contractor.

509.4 FINISHING.

509.4.1 General. The concrete shall be consolidated and the surface finished true to grade and cross-section. Upon completion the surface shall be free of any unevenness greater than 1/8 inch (3.2 mm) when checked with a 10-foot (3 m) straight-edge placed on the surface of the pavement. The straight edge shall be furnished by the contractor and shall be at the site of the work prior to the commencing of the placing of the concrete.

509.4.2 Tamping. The concrete shall be distributed uniformly between the side forms as soon as it is placed after which the concrete shall be struck off and tamped by means of a mechanical tamper. The tamper shall be operated at right angles to the center line of the pavement, and tamping continued until the concrete is thoroughly consolidated to the specified cross-section and sufficient mortar for finishing purposes has been brought to the surface.

Steel-shod hand tampers or vibrating bars may be substituted in those cases where the use of a mechanical spreader and tamper would be obviously impracticable. Approved concrete vibrating equipment shall be used in conjunction with the mechanical tamper to consolidate the concrete adjacent to the forms or existing pavement.

509.4.3 Floating.

- (a) *General.* After tamping, the surface of the concrete shall be floated by either the finishing machine method or the transverse float method described below. Bridge decks may be floated by the longitudinal float method.
- (b) *Finishing Machine Method.* The concrete shall be floated smooth and true to grade with an approved finishing machine.
- (c) *Transverse Float Method.* The concrete shall be floated at least twice with a long-handled float at least 5 feet (1.5 m) wide, following which the surface of the concrete shall be finished smooth and true to grade, with a wooden float 16 feet (4.9 m) long, 2 inches (51 mm) thick, and 6 inches (152 mm) wide. It shall be rigidly ribbed and with adjustable screws between the rib and float board to insure a true and flat surface on the under side at all times. The float shall be operated from the side of the pavement, and parallel with the center line. The edge of the float shall be used to cut down all high areas, and the material so removed shall be floated into the depressions until a true surface is obtained. Each successive pass of the float shall half-lap the previous pass. The float shall be operated as far behind the tamping machine as the workability of the concrete will permit before its initial set.
- (d) *Longitudinal Float Method.* The concrete shall first be floated with a double-handled longitudinal float not less than 16 feet (4.9 m) nor more than 20 feet (6.1 m) in length, having a troweling surface not less than 8 inches (203 mm) nor more than 10 inches (254 mm) wide.

The float shall be operated from bridges over the pavement with its length parallel to the center line of the improvement, and shall be worked back and forth transversely across the slab, planing off high spots and filling depressions. This operation shall be continued until the surface is reasonably smooth, after which the bridges may be advanced not to exceed 2/3 the length of the surface so floated, and the operation continued.

509.4.4 Straight-edge Testing and Surface Correction. After the floating has been completed and the excess water removed but while the concrete is still plastic, the surface of the concrete shall be tested for trueness

with a 10 foot straightedge. For this purpose, the contractor shall furnish and use an accurate 10 foot straightedge swung from handles approximately 3 feet longer than 1/2 the width of the slab. The straightedge shall be held in contact with the surface in successive position parallel to the road centerline and the whole area gone over from one side of the slab to the other as necessary.

Advance along the road shall be in successive stages of not more than 1/2 the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across the joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross section.

509.4.5 Final Finishing. After being finished by one of the above methods, the outside edges of pavement shall be rounded to a 1/2 inch (13 mm) radius; and transverse contact joints expansion joints, and joints adjacent to an existing pavement shall be rounded to a 1/4 inch (6 mm) radius.

Final finish shall be obtained by using a Burlap Drag, in accordance with paragraph (a). Following the drag finish the final texture shall be obtained by the use of metal tines spaced either on 1/2 inch centers or on 1 inch centers. Grooves produced in the concrete shall be 3/16 inch in width with depth tolerances of 1/8 inch to 3/16 inch. All pavements shall conform to this requirement unless otherwise specified on the plans.

- (a) *Drag Finish.* A strip of wetted burlap shall be provided, of a length not less than the width of the pavement slab. It shall be attached by one edge to a rigid frame supported over the pavement so that the free edge of the burlap will rest or drag on the surface of the concrete. The burlap shall be dragged back and forth longitudinally along the pavement until the surface of the slab is of uniform texture and appearance throughout its entire length.
- (b) *Broom Finish.* When permitted or specified, the surface texture shall be a broom finish. It shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. Corrugations produced in surface shall be uniform, 1/16" maximum in depth. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. Finished surface shall be free from rough and porous areas, irregularities and depressions. Contractor will be permitted to use mechanical or manual brooming.
- (c) *Tine Texturing.* The metal tine texturing device shall be operated by approved mechanical means when texturing main roadway pavement lanes. When approved, manual methods may be used for tine texturing of ramps, crossovers, turnouts, split slab construction or other pavement sections. Tine texturing will not be required on parking areas, drives and other such areas. The adjacent concrete shoulder will require the same finish as the pavement.

Tines shall be approximately 0.025 x 0.126 inch (0.63 x 3.20 mm) steel flat wire, 4 to 5 inches (100 to 125 mm) in length, and randomly spaced with a minimum spacing of 3/8 inch (10 mm) and a maximum spacing of 1 1/2 inch (40 mm). No more than 50 percent of the spaces shall exceed 1 inch (25 mm). Grooves produced in the concrete shall be 3/16 inch (5 mm) in depth with a minimum depth of 1/8 inch (3 mm).

Depth of tine texturing on the travel lanes will be checked in accordance with DOTD TR 229. Pavement, which does

not meet the above requirements, will be corrected by regrooving. Tine texture on the shoulders will be visually inspected.

509.5 JOINTS.

509.5.1 General. Joints shall be as shown in the plans and shall be constructed where called for by the plans or where directed by the engineer. Joints in concrete pavements will be designated as longitudinal and transverse construction joints, expansion joints, and longitudinal and transverse contraction joints. All joints and joint fillers shall extend clearly to pavement edge or to each other, as the case may be.

Unless otherwise specified, transverse joints shall be constructed perpendicularly to the center line of the pavement, longitudinal joints shall be constructed parallel to the center line of the pavement. Joints shall not vary from specified or indicated line by more than 1/4 inch. The joint face shall be perpendicular to the surface of the pavement. No vehicular traffic of any kind will be allowed on the pavement until such time that the joints have been properly sealed.

509.5.2 Longitudinal Joint. The longitudinal joint shall not interrupt the continuity of any transverse joint. Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, steel side forms or other approved methods shall be used. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before concrete of the adjacent lane is placed or, in the lieu of bent tie bars, approved 2-piece connectors may be used. Tie bars which break or show evidence of fracture upon straightening shall be replaced when directed by the engineer by drilling 1 inch holes to a depth of 12 inches (31 cm) and pressure grouting the holes before insertion of the tie bars.

509.5.2.1 The groove for the longitudinal joint shall be formed by using a “T” iron wheel or other device that will insure a groove that is true in both vertical and horizontal alignment. All grooves shall be cut to the minimum depth shown on the plans and in such manner that the surface of freshly placed concrete will not be depressed or otherwise disturbed. Retempering of concrete adjacent to joints will not be permitted.

Strips of preformed joint filler material of the dimensions shown on the plans shall be inserted in the groove. After insertion, the top of the strip shall be flush with the surface or slightly below. In no case shall the distance between the top of the insert and the surface of concrete exceed 1/8 inch (3.17 mm). The joint shall be aligned and the surface of the pavement floated and checked with a 10 foot (3.1 m) straight edge. These fillers shall conform to Subsection 201.3.1.

509.5.2.2. A flexible joint forming device of the types shown on the plans may be used. Such joints shall be formed in accordance with plan details and the recommendation of the manufacturer. When the contractor desires to use a joint forming device not shown on the plans, the device and the method of installation must be approved in writing by the engineer.

509.5.2.3 Longitudinal joints may be sawed in conformance with Section 509.5.4.4.

509.5.3 Transverse Expansion Joints: The expansion joint filler shall be one of the following types:

509.5.3.1 Sealing Joints: When wood, bituminous, rubber or cork fillers are used to form the joint, they shall be

sealed in accordance with the plans. When wood filler is used, it shall be immersed in water for a period of not less than 24 hours before installation in the pavement. The boards shall be kept thoroughly wet until installed. The sealer shall conform to Subsection 201.3.3. The expansion joint filler shall be continuous from form to form and shaped to the subgrade. Preformed joint fillers shall be furnished in lengths equal to the pavement width or equal to the width of one lane and depth equal to slab depth. Damaged or repaired joint fillers shall not be used unless approved by the engineer.

The load transfer device shall provide bracing adequate to hold the expansion joint filler in a vertical position. An expansion installing bar or other device shall be used if required to secure preformed expansion joint filler at proper grade and alignment during placing, vibrating and finishing of concrete. Care shall be taken to prevent indentations, deformations or punctures of the filler. Finished joints shall not deviate more than 1/4 inch (6.35 mm) in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted within the expansion space.

509.5.3.2 Transverse expansion joints may be sawed in conformance with Section 509.5.4.4.

509.5.4 **Transverse Contraction Joints (Dummy Joints)**: Transverse contraction joints shall consist of planes of weakness created in cross section of pavement and shall be constructed by one of the following methods:

509.5.4.1 Install a nonbituminous preformed filler board in a groove in the pavement formed and then sawed to the dimensions specified with one pass of the saw.

509.5.4.2 Install an approved removable joint forming device to form a joint to a width slightly less than the required width and to the required depth. The joint shall then be sawed to proper width and depth with one pass of the saw.

509.5.4.3 Install an approved removable joint device to form a joint to the required width and depth. This device shall be vibrated and remain in place for a minimum of 72 hours before removal. These devices may be reused provided they are cleaned of foreign materials and are undamaged in removal. They shall be reused only with prior approval of the engineer. Once the joint device is removed, the joint shall then be sawed to proper width and depth with one pass of the saw. Unless otherwise specified, the joints shall include load transfer devices.

509.5.4.4 Transverse contraction joints (Dummy Joints) may be constructed by sawing to the depths, widths and at the locations as called for by the plans, without tearing, raveling, or uncontrolled cracking of the concrete. Sawing shall be performed as soon as the concrete has set enough to permit sawing without tearing.

509.5.4.5 Transverse expansion joints may be sawed in conformance with Section 509.5.4.4.

509.5.4.6 Longitudinal joints may be sawed in conformance with Section 509.5.4.4.

509.5.4.7 Transverse Construction Joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet of an expansion joint, contraction joint or plane of weakness. If sufficient concrete has been mixed at the time of interruption to form a slab at least 10 feet (3.1 m) long, the excess concrete back to the preceding joint shall be removed and disposed of as directed. Hand vibrators shall be used to ensure proper consolidation of the concrete adjacent to the construction joint.

509.5.6 Load Transfer Devices: Load transfer devices, either dowel assemblies or cantilever type assemblies, as specified hereinafter. Dowels shall be held in positions parallel to the surface and centerline by a metal basket with sand shoes that are left in the pavement. Load transfer devices may be placed by an approved mechanical device provided satisfactory positioning and alignment is attained. Load transfer devices for construction joints shall be the dowel assembly type.

509.5.6.1 Dowel Bars: Dowel bars shall be plain round bars conforming to ASTM Designations: A 615, A 616, or A 617. The sleeves for dowel bars shall be an approved material and design to cover 2-inches of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least 1 inch from the end of the dowel bar. Dowels shall be smooth, free of burrs, projections and deformations which may prevent pavement slippage. Dowels shall be coated with one coat of an approved paint and thoroughly coated with an approved lubricant to prevent concrete from bonding to the dowel. In lieu of painted and lubricated dowels, plastic coated dowel bars may be used. An approved sleeve shall be furnished with each dowel bar used in expansion joints. The sleeve shall fit the dowel bar tightly and the closed end shall be watertight.

Paint to be used for painting dowel bars shall conform to AASHTO Designation: M 72. Plastic coated dowel bars shall be undercoated with an adhesive and then given a final outer coat of approved extruded polyethylene plastic.

509.5.6.2 Cantilever Devices: Cantilever type devices shall be fabricated cast malleable iron conforming to details shown on the plans. The castings forming each of the 2 sections shall be of material conforming to ASTM Designation: A 47, Grade No. 35018. Each load transmission unit of the cantilever type shall consist of 2 identical castings providing a cantilever arm on which the other half of the unit shall bear, and each casting shall have an upper tension anchor and a lower compression anchor, all constructed in accordance with the general dimensions shown on the drawings.

The castings shall be cleaned and ground as necessary in order that each may be in conformity with the required dimensions and assembled into complete unit providing coincidence of bearing on both the vertical and horizontal sliding faces. The castings shall be sufficiently smooth so that there will be no interference with smooth sliding operation.

509.5.7 Overlaid Pavement. Where the plans provide that concrete pavement be overlaid with asphaltic concrete, the sawing and sealing of longitudinal and transverse joints will not be required.

509.6 CURING. The pavement shall be cured by a concrete curing compound conforming to the requirements of Subsection 201.4. Curing shall commence as soon as free water leaves the surface of the concrete but not later than 3 hours following the deposit of the concrete upon the subgrade. The entire pavement surface shall be covered with Type 1, 2 or 3 pigmented curing compound, as approved by the Engineer. The curing compound shall be applied to the entire pavement surface, by spraying at the rate of 1 gallon per 200 square feet (1 liter per 5 square meters) of pavement surface.

Spraying equipment shall be of the fully atomizing type, equipped with a tank agitator of an approved type which provides for continual agitation of the compound during application. The use of non-agitating type hand pumped garden sprayers will not be permitted except for small and inaccessible areas as may be permitted by the Engineer.

509.6.1 Surface Test: As soon as the concrete has hardened, the pavement surface shall be tested with a 10 foot rolling straightedge or other device approved by the City. The testing device shall be provided and calibrated by the contractor. The contractor shall also perform the test in the presence of a city inspector.

Areas showing high spots of more than 1/8 inch on roadways and 1/4 inch on ramps and connections, but down with an

approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10 foot straightedge, except deviations of 1/4 inch will be permitted on ramps or connections with radii of 250 feet or less and on ramps with grades of 4 percent or more. Where the surface deviation in 10 feet exceeds 1/2 inch, the pavement shall be removed and replaced by and at the expense of the contractor.

509.7 TRAFFIC AND USE PROVISIONS. The concrete pavement shall be immediately barricaded upon its installation, and no vehicular traffic will be permitted thereon until the expiration of at least 7 days.

Pavement constructed of concrete which has been treated in accordance with Subsection 201.1.1.1 to obtain an early increase in strength may be opened to traffic 3 days after it is placed, if directed by the Engineer.

At least 3 days shall elapse from the time the concrete is placed before any mechanical tamper, spreader, or finishers which will be supported by the edge of the new pavement may be operated in adjacent lanes.

509.8 MEASUREMENT AND PAYMENT. Payment for concrete pavement will be made on a square-yard basis as shown in the Proposal. The price bid for concrete pavement shall be considered to include full payment for all materials, labor, equipment and incidentals required to place the concrete pavement in accordance with the Drawings or these Specifications. Length and width measurements to determine the quantity will be made in horizontal planes.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
509 (1)	Portland Cement Concrete Pavement (____" Thick)	Square Yard

PART 6

CONCRETE CONSTRUCTION

SECTION 601

CONCRETE STRUCTURES

601.1 GENERAL. Concrete bridges, culverts, catch basins, retaining walls, abutments, piers, footings, foundations and similar structures shall be constructed in conformity with the Drawings. Concrete for use in work constructed under this section shall conform to the requirements of Subsection 201.1. When the class of concrete is not specified or indicated on the Drawings, the class of concrete used shall be Class A.

601.2 SUBGRADE FOR CONCRETE STRUCTURES. Earth subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept below subgrade until the concrete has set. When the subgrade is in dry earth, it shall be thoroughly dampened with water to insure that no moisture will be absorbed from the fresh concrete. When the design details for the project provide for the construction of filter or drain material consisting of gravel (or combination of gravel, clay, sand), which material will be subgrade for concrete, the placing of steel reinforcement and placement of concrete shall follow the installation of the filter or drain material as closely as practical. The filter or drain material shall be kept de-watered to the extent necessary to prevent any portion of concrete materials being deposited in water. No payment will be made for de-watering other than as may be included in the prices bid for various items of work or when an item for de-watering is provided.

601.3 FORMS. Forms shall be of suitable material and of a type, size, shape, quality, and strength to insure construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist deflection during placing of the concrete. The responsibility for their adequacy shall rest with the contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited therein. The surface of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being re-used. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent which will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber, or material which will provide a surface at least equal to surfaced lumber or plywood. Any lumber or material which becomes badly checked or warped, prior to placing concrete, shall not be used.

Forms for all exposed surfaces of bridges, viaducts, over-crossings and similar structures shall be constructed of plywood or an approved equal. Plywood for forms shall be of the grade "Exterior B-B (concrete form)", conforming to the latest Product Standard for Soft Plywood, Construction and Industrial, of the National Bureau of Standards.

Unless otherwise shown on the plans, all sharp edges shall be chamfered with 3/4-inch by 3/4-inch (19 mm by 19 mm) triangular fillets. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate from the arc of the curve. Forms for girders and slabs shall be cambered as may be required by the Engineer.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the Engineer. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch (25.4 mm) inside the finished surface of the concrete. All forms for outside surfaces shall be constructed with stiff wales at right angles to the studs, and all form clamps or bolts shall extend through and fasten such wales.

Forms for cast-in-place concrete drain conduits or sewer structures will not be required for concrete to be placed directly against the sides of the excavation, provided the faces of the excavation are firm, compact, able to stand without sloughing, and must be outside the concrete lines shown on the plans at all points.

601.4 REMOVAL OF FORMS.

601.4.1 General. The periods of time for form removal set forth herein are permissive only and subject to the contractor assuming all risks that may be involved. The time periods are minimum with no allowance therein for external loads. At times of low temperature, or other adverse conditions, the Engineer may require the forms to be kept in place for longer periods of time.

601.4.2 Bridges. The period of time set forth herein are based on the use of Type II cement. Forms and false work supporting concrete beams, arch ribs, slabs, or other members subject to direct bending stress shall not be removed in less than 21 days after the concrete has been placed, unless concrete test cylinders show a strength of not less than 3,000 pounds per square inch (20.68 MPa) in compression, when cured under conditions similar to those affecting the structure. Forms and false work supporting the bottom slab of the superstructure of box girder structures shall remain in place 14 days after placing of the deck of the superstructure. Forms for the webs of box girders shall be removed before the deck slab is placed. Side forms for beams, girders, columns, railings, or other members in which the forms do not resist dead load bending, may be removed within a period of 2 to 5 days, as authorized by the Engineer, provided that satisfactory arrangements are made to cure and protect the concrete thus exposed.

601.4.3 Miscellaneous Structures. The period of time set forth herein are based on the use of Type II cement. Forms for concrete members (except bridges) subject to bending stresses, where the member relies upon forms for vertical support, may be removed 7 days after concrete is placed. Curb forms shall not be removed until the concrete has set sufficiently to hold its shape but shall be removed in time to permit proper finishing.

601.4.4 Standard Structures.

(a) General. Except as otherwise stipulated, the periods of time set forth herein for removal of forms are based on the use of Types II, III, IV, or V portland cement.

(b) Standard Catch Basins.

- (1) Outside forms and inside wall forms which do not support the top slab forms -----16 hours.
- (2) Top slab forms-----48 hours if Type II or V cement is used;
24 hours if Type III cement is used.

(c) Standard Transition Structures.

(1) Outside forms and inside wall forms which do not support the top slab form-----16 hours.

(2) Top slab forms-----as specified for box section slab forms.

601.4.5 Channels and Conduits.

(a) General. Except as otherwise specified, the periods of time set forth herein are based on the use of Types II, III, IV or V portland cement.

(b) Forms Removal. Forms for open channels and forms and shoring for box sections and arch sections of sewers and storm drains may be removed as follows:

(1) Forms for open channel walls,-----16 hours.

(2) Outside forms of box sections and inside wall forms of box sections which do not support the slab forms-----16 hours.

(3) Arch sections in open cut-----12 hours.

(4) Slab forms for box sections-----Design strength.

(a) Type II cement-----48 hours or 6 hours per foot (19 hours per meter) of span between supports, whichever is greater.

(b) Types III cement-----24 hours or 3 hours per foot (9.85 hours per meter) of span between supports, whichever is greater.

(c) Type V cement-----56 hours or 7 hours per foot (22.96 hours per meter) of span between supports, whichever is greater.

601.5 FALSE WORK. The contractor shall submit detailed plans of the false work proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the false work, and typical soil conditions. All false work shall be designed and constructed to provide the necessary rigidity and to support the loads. False work for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

False work and forms shall be so constructed as to produce in the finished structure the lines and grades indicated on the plans. Suitable jacks or wedges shall be used in connection with the false work to set the forms to the grade or camber shown on the plans, or to take up any settlement in the form work before or during the placing of concrete. Single wedges for this purpose will not be permitted, it being required that all such wedges be in pairs to insure uniform bearing. Dead load deflection in stringers and joists will be compensated for by varying the depths of the joists or by using varying depth nailing strips. Arch centering shall be removed uniformly and gradually, beginning at the crown and

working toward the haunches to permit the arch to take its load slowly and evenly. Centering for adjacent arch spans shall be struck simultaneously.

601.6 PLACING REINFORCEMENT.

601.6.1 General. Before placing reinforcement steel, the contractor shall submit a reinforcing steel placing plan. Reinforcing bars shall be accurately placed as shown on the plans and shall be firmly and securely held in place in accordance with the "Manual of Standard Practice" of the Concrete Reinforcing Steel Institute, using concrete or metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under full load. Metal chairs which extend to the surface of the concrete (except where shown on the plans) and wooden supports, shall not be used. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete shall not be permitted. Before placing in the form, all reinforcing steel shall be cleaned thoroughly of mortar, oil, dirt, loose mill scale, loose or thick rust, and coatings of any character that would destroy or reduce the bond. No concrete shall be deposited until the placing of the reinforcing steel has been inspected and approved.

601.6.2 Splicing. Splices of bars shall be made only where shown on the plans or as approved by the Engineer. Where bars are spliced, they shall be lapped at least 30 diameters, unless otherwise shown on the plans. Splicing shall be accomplished by placing the bars in contact with each other and wiring them together. Welding of reinforcing steel will not be permitted unless specifically authorized by the Engineer.

601.6.3 Bending Reinforcement. Bends and hooks in bars shall be made in the manner prescribed in the "Manual of Standard Practice" of the Concrete Reinforcing Steel Institute. Bars shall not be bent or straightened in a manner which will injure the material. Bars with kinks or unspecified bends shall not be used.

601.6.4 Welded Wire Fabric. Welded wire fabric shall be spliced not less than two meshes.

601.7 PLACING CONCRETE.

601.7.1 General. Concrete shall be conveyed, deposited, and consolidated by any method which will preclude the segregation or loss of ingredients. Equipment used in conveying and depositing concrete shall not have any aluminum component coming into direct contact with the concrete. All surfaces against which concrete is to be placed shall be thoroughly moistened with water immediately before placing concrete. All ponded and excess water shall be removed to leave surface moist but not flooded. Chutes used in conveying concrete shall be sloped to permit concrete of the consistency required to flow without segregation. Where necessary to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet. Where a sequence for placing concrete is shown on the plans, no deviation will be permitted unless approved in writing by the Engineer.

601.7.2 Grouting. Where concrete is to be deposited against hardened concrete at horizontal construction joints, placing operations shall begin by conveying a grout mixture through the placing system and equipment and depositing the mixture on the joint. The grout mixture shall consist of a modification of the concrete specified to reduce the quantity of coarse aggregate in the mix larger than pea gravel size to one-half the quantity specified.

601.7.3 Depositing. To avoid segregation, concrete shall be deposited as near to its final position as is practicable. The use of vibrators for extensive shifting of the mass of concrete will not be permitted. Concrete that has been partially hardened, has been retempered, or is contaminated by foreign materials shall not be deposited in the

structure.

Concrete shall be placed in horizontal layers insofar as practical. Placing shall start at the low point and proceed upgrade unless otherwise permitted by the Engineer. Concrete shall be placed in a continuous operation between construction joints and shall be terminated with square ends and level tops unless otherwise shown on the plans. Concrete shall not be permitted to fall more than 6 feet (1.829 m) without the use of pipes or tremies.

Pipes and tremies shall be at least 6 inches (152 mm) in diameter, or the equivalent cross sectional area for rectangular sections. Concrete shall not be placed in horizontal members or sections until the concrete in the supporting vertical members or sections has been consolidated and a 2-hour period has elapsed to permit shrinkage to occur.

601.7.4 Consolidating. Concrete shall be thoroughly consolidated in a manner that will encase the reinforcement and inserts, fill the forms, and produce a surface of uniform texture free of rock pockets and excessive voids. Structural concrete, except slope paving such as spillway aprons and channel lining, and concrete placed under water, shall be consolidated by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The location, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without separation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Internal vibrators shall not be held against the forms or reinforcing steel.

The number of vibrators employed shall be sufficient to consolidate the concrete within 15 minutes after it has been deposited in the forms. At least two vibrators in good operating condition shall be available at the site of the structure in which more than 25 cubic yards (19.114 m³) of concrete is to be placed.

601.7.5 Joints. The work shall be so prosecuted that construction joints will occur at designated places on the plans unless otherwise authorized by the Engineer. The contractor shall construct, in one continuous concrete placing operation, all work comprised between such joints. Joints shall be kept moist until adjacent concrete is placed. Expansion and contraction joints in concrete structures shall be formed where shown on the plans. No reinforcement shall be extended through the expansion joints, except where specifically noted or detailed on the plans.

601.7.6 Placing Concrete Under Adverse Weather Conditions. Concrete for structures shall not be placed on frozen ground nor shall it be mixed or placed while the atmospheric temperature is below 35 degrees F (1.67 degrees C), unless adequate means are employed to heat the aggregates and water, and satisfactory provisions have been made for protecting the work.

Concrete slabs shall not be placed on frozen ground, nor shall concrete be mixed or placed when the atmospheric temperature is below 35 degrees F (1.67 degrees C), or when conditions indicate that the temperature may fall to 35 degrees F (1.67 degrees C) within 24 hours, except with the written permission of the Engineer and only after such precautionary measures for the protection of the pavement have been taken as the Engineer may direct. Concrete shall be effectively protected from freezing or frost for a period of 5 days after placing.

Concrete for structures shall not be mixed or placed while the atmospheric temperature is above 115 degrees F (46 degrees C) unless adequate means are employed to cool the aggregate and water and satisfactory provisions have been made for protecting the work. In any case, the temperature of the concrete as placed shall not exceed 90 degrees F (32 degrees C). Concrete placement shall be stopped when rainfall is sufficient to cause damage to the work.

601.7.7 Concrete Deposited Under Water. When conditions render it impossible or inadvisable to dewater excavations before placing concrete, the contractor shall deposit under water, by means of a tremie when Permission is

granted by the Engineer. Concrete deposited in water shall be carefully placed in a compact mass and shall not be disturbed after being deposited. Water shall be maintained in a still condition at the point of deposit.

A tremie shall consist of a water-tight tube having a diameter of not less than 10 inches (254 mm) with a hopper at the top. The tube shall be equipped with a device that will close the discharge end and prevent water from entering the tube while it is being charged with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of the work to prevent water entering the tube and shall be entirely sealed at all times, except when the concrete is being placed. The tremie tube shall be kept full of concrete. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed and the resulting concrete seal shall be monolithic and homogeneous.

601.8 SURFACE FINISHES.

601.8.1 General. The classes of surface finish described herein shall be applied to various parts of concrete structures as specified. The invert of cast-in-place sewers and sewer structures shall be given a steel trowel finish. The invert in circular conduit is defined as the unlined portion of lined conduit or the bottom 60 degrees of circumference of the inside of unlined conduit. Unless otherwise specified, the invert of cast-in-place storm drains shall be given a wood float finish.

601.8.2 Ordinary Surface Finish. Immediately after the forms have been removed, all exterior form bolts shall be removed to a depth of at least 1 inch (25.4 mm) inside the surface of the concrete and the resulting holes or depressions cleaned and filled with mortar, except on the interior surfaces of box girders the bolts may be removed flush with the surface of the concrete. Mortar shall be Class "C" as specified in Subsection 201.5. White cement shall be added to the mortar in an amount sufficient to tint the mortar a shade lighter than the concrete to be repaired. Mortar shall be mixed approximately 45 minutes in advance of use. Care shall be exercised to obtain a good bond with the concrete. After the mortar has thoroughly hardened, the surface shall be rubbed with a Carborundum stone in order to obtain the same color in the mortar as in the surrounding concrete. All fins caused by form joints, and other projections shall be removed and all pockets cleaned and filled. Mortar for filling pockets shall be treated as specified for bolt holes.

Ordinary surface finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher class finish. On surfaces which are to be buried underground or surfaces which are completely enclosed, the removal of fins and form marks and the rubbing of a mortared surface to a uniform color will not be required. Ordinary surface finish, unless otherwise specified, shall be considered as a final finish on the following surfaces:

- (1) The undersurface of slab spans, box girders, filled spandrel arch spans and floor slabs between T-girders of superstructures except for grade separation structures.
- (2) The exposed surfaces of channel walls and the inside vertical surface of T-girders of superstructures except for grade separation structures.
- (3) Surfaces which are to be buried underground, covered with fill, or for surfaces of culverts above finish grade which are not visible from the traveled way.

(4) Top surfaces which are to be buried underground shall be struck off and given a float finish.

601.8.3 Class 1 Surface Finish. Class 1 surface finish shall be applied to the following surfaces, unless otherwise specified.

(1) All surfaces of superstructures for grade separation structures.

(2) All surfaces of bridge piers, columns and abutments, culvert head walls and retaining walls above finished ground and to at least one foot below finished ground.

(3) The outside surfaces and bottom surface of outside girders, and the outside vertical surfaces and the under surfaces of cantilever sidewalks, safety curbs and floor slabs overhanging outside girders.

(4) Surfaces inside of culvert barrels having a height of 4 feet (1.22 m) or more for a distance inside the barrel at least equal to the height of the culvert.

After completion of the ordinary surface finish, the entire surface specified shall be sanded with a power sander or other approved abrasive means as required to obtain a uniform color and texture. The use of power Carborundum stones or discs will be required to remove unsightly bulges or irregularities.

The Class 1 surface finish shall not be applied until after the surfaces have been exposed to the elements for a period of 30 days, or until a uniform appearance of the surfaces can be secured. The specification for a Class 1 finish requires a smooth, even surface of uniform appearance with unsightly bulges removed and depressions due to form marks and other imperfections repaired. The degree of care in building forms and the character of materials used in form work are a contributing factor in the amount of such sanding and grinding required, and the Engineer shall determine the extent of such work required to meet the standard of this class of finish.

601.8.4 Class 2 Surface Finish. Class 2 surface finish shall be applied to the following surfaces unless otherwise specified:

All surfaces of concrete railings, including barrier railings, rail posts, rail end posts, and rail base. When Class 2 surface finish is specified, the ordinary surface finish and Class 1 surface finish shall be completed in succession. The process specified under Class 2 surface finish shall then be deferred until all other work which would in any way affect or mar the final finish is complete. The contractor shall then apply a brush coat or surface film of Class "A" mortar.

601.8.5 Special Surface Finish. Special surface finish will be allowed as a contractor's alternate in lieu of Class 1 and Class 2 surface finishes. When the special surface finish is used, it shall be used throughout the project in lieu of Class 1 and Class 2 surface finishes. The use of the special surface finish shall not relieve the contractor of full responsibility for performing the ordinary surface finish as required immediately following the removal of the forms.

The application of the special surface finish shall be in strict accordance with the manufacturer's instructions, and shall not be started until all other work which might damage or mar the surface finish is complete nor until finishing operations can be carried out continuously from beginning to completion on any structure. The mixture to be used shall be approved by the Engineer prior to use and the contractor shall submit manufacturer's data and a list of projects where the product has been used. The material from only one manufacturer shall be used on one structure.

601.9 CURING. As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall either be sprinkled with water, covered with plastic sheet, or covered with burlap, or when not required to be painted, sprayed with Type I curing compound conforming with Subsection 201.4.

When an impervious membrane (curing compound) is used, it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film.

The membrane shall not be applied to any surface until all of the finishing operations have been completed; such surfaces being kept damp until the membrane is applied. All surfaces on which a bond is required, such as construction joints, sheer planes, reinforcing steel, and the like, of the curing compound in order to prevent any of the compound from being deposited thereon; and any such surface with which the compound may have come in contact shall immediately thereafter be cleaned.

Care shall be exercised to prevent any damage to the membrane seal during the curing period. Should the seal be damaged before the expiration of 10 days after the placing of the concrete, additional impervious membrane shall be immediately applied over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface so exposed shall either be immediately sprayed with a coating of the curing compound, or kept continuously wet by the use of burlap or other suitable means until such concrete has cured for at least 10 days. When tops of walls are cured by the curing compound method, the side forms, except for metal forms, must be kept continuously wet for the 10 days following the placing of the concrete.

601.10 PAYMENT. Payment for concrete structures will be made in conformity with the terms of the contract and will be based on unit prices of lump sums as set forth in the Proposal. When payment is provided for on a lump sum basis, such payment shall include full compensation for furnishing all labor, materials, reinforcing steel, tools and equipment and doing all work required to construct the structure in conformity with the plans and specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the specified dimensions. Unit prices shall include furnishing all labor, materials, reinforcing steel, tools and equipment.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
601(1)	Class A Concrete	Cubic Yard
601(2)	Class D Concrete	Cubic Yard
601(3)	Class R Concrete	Cubic Yard
601(4)	Class S Concrete	Cubic Yard
601(5)	Single Curb Inlets	Each
601(6)	Double Curb Inlets	Each
601(7)	Triple Curb Inlets	Each
601(8)	Grate Inlets (Types)	Each
601(9)	Cast-in-place Manholes	Each
601(10)	Junction Boxes	Each
601(11)	Headwalls	Cubic Yard
601(12)	Concrete Foundations (mast arm, street light)	Each

SECTION 602

PNEUMATIC PLACED CONCRETE

602.1 GENERAL. Air placed concrete construction shall be in accordance with this subsection and the applicable provisions of Section 601. Only personnel skilled in the techniques of air placement of concrete shall be utilized for air placed concrete construction. Unless otherwise specified, air placed concrete shall be applied by one of the following methods:

602.1.1 Method A (Guniting). A proportional combination of portland cement and aggregate pneumatically transported in a dry state through a pipe or hose to a nozzle where water is added immediately prior to discharge.

602.1.2 Method B (Shotcrete). A proportioned combination of portland cement, aggregate, and water mixed by mechanical methods, pumped in a plastic state through a pipe or hose to the nozzle where, by the addition of air, the mixture is forcibly propelled to the work.

602.2 EQUIPMENT. For Method A, the minimum air pressure shall be 45 psi (310.3kPa) on the gun tank when 100 feet (30.5 m) or less of hose is used and the pressure shall be increased 5 psi (34.5kPa) for each additional 50 feet (15.2 m) of hose. The pressure shall also be increased 5 psi (34.5kPa) for each 25 feet (7.6 m) that the nozzle is located above the elevation of the gun tank. The maximum nozzle diameter shall be 1-5/8 inches (41.3 mm) unless otherwise permitted by the Engineer. Water pressure at the nozzle shall be at least 15 psig (103.4kPa) above the air pressure at the nozzle.

For Method B, the pump system utilized to convey premixed concrete shall deliver a uniform and uninterrupted flow of material, without segregation or loss of the ingredients. The main run from the pump to the work shall be at least 3-inch (76 mm) diameter steel pipe or flexible hose reduced to 2-inch (51 mm) diameter at the point of expulsion. Aluminum pipe will not be permitted. The air compressor shall have the capacity to deliver at least 100 cubic feet per minute (.047m³/s) for each operating nozzle.

602.3 MATERIALS, PROPORTIONING AND MIXING

602.3.1 Method A. Aggregates and portland cement shall comply with Subsections 200.1.3 and 200.1.2 respectively. Unless otherwise specified, the proportions by volume shall be 1 part cement to 4-1/2 parts sand. The sand shall contain not less than 3 percent nor more than 6 percent moisture by weight. The cement and sand shall be mixed thoroughly in a power mixer for at least 1-1/2 minutes. The dry-mixed material shall be used promptly after mixing and any material that has been mixed for more than 45 minutes shall be rejected and removed from the work site.

602.3.2 Method B. The concrete class shall comply with Subsection 201.1.1.2.

602.4 TESTS. The contractor shall make the work accessible to facilitate the preparation of test specimens. The strength of pneumatic placed concrete shall be determined from cores cut from the completed work, cores cut from test panels, compression test cylinders or a combination of these methods as directed by the Engineer.

The minimum strength of test specimens shall be:

7 day (cylinders)	2000 psi (13.79 MPa)
14 day (cores)	2300 psi (15.86 MPa)
28 day	3250 psi (22.41 MPa)

When a test specimen shows deficient strength, two cores taken from adjacent areas at the contractor's expense may be required for each deficient specimen. Should either core prove deficient, the work shall be subject to rejection.

602.5 PREPARATION OF SURFACES. Earth subgrade for pneumatic placed concrete shall be neatly trimmed to line and grade and free of all loose material. The subgrade shall be compacted as required by the plans.

Masonry, rock, asphalt and concrete surfaces to be covered by pneumatic placed concrete shall be free of loose material. Dust, dirt, grease, organic material or other deleterious substances shall be removed and the surface washed with water.

602.6 PLACEMENT. All surfaces shall be dampened before application and material shall not be applied to a surface on which free water exists. The velocity of the material as it leaves the nozzle shall be maintained uniformly at a rate satisfactory for the job conditions. Material that rebounds and does not fall clear of the work, or which collects on the surfaces, shall be removed. Rebound shall not be used in any portion of the work.

The nozzle shall be held at such distance and position that the stream of flowing material will impinge approximately at right angles to the surface being covered. Any portion of the in-place material which sags, is soft, contains sand pockets, or shows other evidence of being defective, shall be removed and replaced with new material. Reinforcement damaged or destroyed by such repairs shall be replaced by properly lapped additional steel.

Mortar blocks, metal chairs, clips, or spacers with wire ties, or other acceptable means shall be used to secure the reinforcement firmly in the position shown on the plans. Where material is placed on overhead surfaces, the amount of water in the mix shall be controlled to permit placement of layers of material approximately 3/4 inch (19 mm) thick without sag or slough.

602.7 FORMS AND GROUND WIRES. The forms shall be built in accordance with the applicable provisions of Subsection 601.3. All forms shall be constructed so as to permit the escape of air and rebound. Ground wires shall be installed in such a manner that they accurately outline the finished surface as indicated on the plans. They shall be located at intervals sufficient to insure proper thickness throughout. Wires shall be stretched tight and shall not be removed prior to application of the finish coat. Headers will be required where the plans indicate a formed edge or joint.

602.8 JOINTS. Construction joints shall be sloped off at an angle of approximately 45 degrees to the surface to which air placed material is being applied. Before applying air placed material in the adjacent sections, the sloped portion shall be thoroughly cleaned and wetted by means of air and water blast. Control joints shall be formed at the locations designated on the plans.

602.9 FINISH. Upon reaching the thickness and shape outlined by forms and ground wires, the surface shall be rodded off to true line and grade. Low spots or depressions shall be brought up to proper grade by placing additional air placed material. Ground wires shall then be broom finished to secure a uniform surface texture. Rodding and

working with a wood float will be held to a minimum. Rebound or accumulated loose sand shall be removed and disposed of by the contractor. When a nozzle finish is specified on the plans, the surface upon which the finish is to be applied shall be at the proper grade and prepared by sand and water blasting to remove all laitance prior to application of the concrete.

602.10 CURING. Air placed concrete shall be cured as prescribed in Subsection 601.9. The contractor shall, at all times, protect the finished work from being scarred or damaged.

602.11 MEASUREMENT AND PAYMENT. Quantities of pneumatic placed concrete will be computed from measurements of actual areas in the plane of the work and the dimensions shown on the plans. No compensation will be allowed for material placed in excess of the dimensions shown on the plans. The bid item price for pneumatic placed concrete shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals involved in the performance of the work. Such work shall include preparing the foundation, setting all form work and grounds, furnishing surfaces, curing, and structure backfill as shown on the plans.

Item No	Pay Item	Pay Unit
602 (1)	Pneumatic placed concrete	Cubic Yard

SECTION 603

PRECAST CONCRETE

603.1 DESCRIPTION. This specification covers the manufacture of precast reinforced concrete catch basins, drop inlets and manhole units. The finished units shall conform to the dimensions shown on the Drawings.

603.2 MATERIALS. The materials shall conform to the following Subsections: Portland cement concrete Subsection 201.1, reinforcing steel Subsection 201.2, manhole steps, frames, grates and covers Subsection 207.5.3, mortar Subsection 201.5, gaskets Subsection 201.3.1.

603.3 MANUFACTURE.

603.3.1 Testing and Inspection. Acceptability of the units will be determined by the results of compression tests on concrete cylinders and by inspection during manufacture, when required by the Project Specifications or the Engineer, to determine their conformance with the design and workmanship prescribed in these specifications and on the plans. The units shall attain a strength of 4,000 psi prior to shipping. Compressive strength tests shall be in accordance with AASHTO T22.

The units shall be considered ready for acceptance regardless of age when they conform to the strength requirements, as indicated by the specified tests. The manufacturer shall furnish all facilities and assistance required to carry on the sampling and testing in an expeditious and satisfactory manner.

603.3.2 Reinforcement. Reinforcement shall be as shown on the plans, with the following permissible variations in position:

Except at pipe connections, variations in the position of the reinforcement shall not exceed 1/4 inch (6.35 mm) from the position shown in the design. The cover on the reinforcement shall not be less than that shown on the plans.

603.3.3 Casting. When multiple castings are to be made using the same forms, form material shall be metal. The concrete in each sectional unit shall be placed without interruption, and shall be consolidated by the use of an approved vibrator, supplemented by such hand-tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes.

603.3.3.1 Openings for Pipes. Each opening shall be 4 (10.2 cm) $\pm$ 1/2 12.7 mm) inch larger than the outside diameter of the pipe for which it is provided.

603.3.3.2 Steps and Ladders. When steps are required, the steps that are cast or mortared into the walls shall be aligned in each section so as to form a continuous ladder with rungs equally spaced vertically in the assembled unit.

603.3.4 Curing: The units shall be cured by steam curing or water curing methods as given herein for a sufficient length of time so that the concrete will develop the specified compressive strength.

(1) Steam Curing: The units may be steam cured as specified in Subsection 604.2.

(2) Water Curing: The units may be cured by being kept wet for not less than 72 hours under normal summer temperature conditions. In colder weather the water curing period shall be extended, as directed by the engineer, to provide equivalent curing. The units shall be protected from freezing from the time the concrete is placed and until curing is completed.

603.3.5 Removal of Forms. The forms shall remain in place until they can be removed without damage to the unit.

603.3.6 Workmanship. The unit shall be true to shape and their surfaces shall be smooth, dense and uniform in appearance. When approved by the engineer, minor surface cavities or irregularities which do not impair the service value of the unit and which can be corrected without marring its appearance shall be pointed with approved mortar as soon as the forms are removed. Such minor defects shall not constitute cause for rejection.

603.3.7 Rejection. Units shall be subject to rejection because of failure to meet any of the requirements specified above; and in addition, any of the following defects shall be cause for rejection.

- (1) Defects that indicate imperfect mixing and molding.
- (2) Defects indicating honeycombed or open texture.
- (3) Exposure of the reinforcement when such exposure would indicate that the reinforcement is misplaced.

603.3.8 Marking. The name or trademark of the manufacturer and date of casting shall be stenciled on the unit in such a manner as to be clearly legible at time of delivery.

603.4 CONSTRUCTION REQUIREMENTS. Concrete construction shall conform to Section 601. Joints shall be full mortar joints and shall not be more than ½ inch (12.7 mm) wide. When specified, the outside faces of structures shall be plastered with ½ inch (12.7 mm) thick cement-sand mortar coat. Unless otherwise provided, exposed surfaces of concrete and masonry shall be cured by approved methods for a period of not less than 48 hours.

Precast concrete units shall be cast with the specified number and size of pipe openings to incorporate the unit into the drainage system; however, if additional pipe is required during construction for which no holes have been provided any damaged units are replaced or satisfactorily repaired. Precast units shall be set to within $\pm \frac{1}{2}$ (12.7 mm) inch of established grade on bedding material as shown on the plans or approved by the engineer. Joints for sectional precast units shall be sealed with flexible plastic gasket material so installed as to form a watertight seal.

Metal frames shall be set in full mortar bed. Conduit sections shall be flush on the inside of the structure wall and project outside sufficiently for proper connection with the next pipe section.

603.5 METHOD OF MEASUREMENT. Junction boxes, manholes, inlets and catch basins, both new and adjusted, will be measured by the unit. Excavation required for installation of these units will be considered incidental to the work and will not be measured for separate payment. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. The design volumes are based on the plan depths of the structure and vertical planes 18 inches (46 cm) outside of and parallel to the neat lines of the structure as shown on the plans.

603.6 BASIS OF PAYMENT. The accepted quantities of new and adjusted junction boxes, manholes, inlets, and catch basins will be paid for at the contract unit price per each complete in place.

Item No	Pay Item	Pay Unit
603 (1)	Junction boxes	Each
603 (2)	Precast Manholes	Each
603 (3)	Inlets	Each
603 (4)	Catch Basins	Each

SECTION 604

PRESTRESSED CONCRETE

604.1 GENERAL. This work shall consist of furnishing and placing pre-tensioned or post-tensioned pre-stressed concrete members, and shall include the manufacture, transportation, and storage of girders, slabs, piling, and other structural members of pre-stressed concrete, and placing of all pre-stressed concrete members, except piling which shall be placed as provided in Section 901. The members shall be furnished complete including all concrete, pre-stressing steel, reinforcing steel, and incidental materials.

Pre-stressing shall be performed by either pre-tensioning or post-tensioning methods. The method of pre-stressing to be used shall be optional with the contractor, within the limitations of these specifications. Prior to casting any members, the contractor shall submit complete drawings and details of the method, materials, concrete mix and equipment to be used in the pre-stressing operations.

604.2 CONCRETE. Concrete construction shall conform to the applicable provisions in Sections 509 and 601. The design of the precast pre-stressed concrete members is based on the use of concrete having an ultimate compressive strength at 28 days of not less than the values shown on the plans. The contractor shall be responsible for furnishing concrete for pre-stressed members which contains not less than 560 pounds (334 kg) nor more than 750 pounds (446 kg) of cement per cubic yard (meter) of concrete, which is workable, and which conforms to the strength requirements specified.

The compressive strength of the concrete will be determined from concrete test cylinders cured under conditions similar to those affecting the members. The use of admixtures shall be as specified in Subsection 201.1.5. The concrete shall be vibrated internally or externally, or both, as required to consolidate the concrete. The vibrating shall be done with care and in such a manner that displacement of reinforcement, enclosures, and pre-stressing steel will be avoided.

Holes for anchor bars, and for diaphragm dowels which pass through the member, openings for connection rods, recesses for grout, and holes for railing bolts shall be provided in the members in accordance with the details shown on the plans. Where diaphragm dowels do not pass through the member, the dowels may be anchored in the member by embedment in the concrete or by means of an approved threaded insert. Lifting anchors shall be installed as detailed on shop drawings. In members to be placed in bridge decks, all portions of the anchor above the concrete shall be removed after the members are placed.

The steam curing method or other methods approved by the Engineer may be used for curing precast, pre-stressed concrete members in lieu of water curing. Steam curing, if elected by the contractor, shall conform to the following provisions: Steam curing, when selected by the contractor, shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam may be from 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If retarders are used, the waiting period before application of the steam may be increased from 4 to 6 hours. The steam shall be at 100 percent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement.

Application of the steam shall not be directly on the concrete. During application of the steam the ambient air temperature shall increase at a rate not to exceed 40 degrees F (7 degrees C) per hour until a uniform temperature

not exceeding 160 degrees F (61 degrees C) is reached. This temperature shall be held until the concrete has reached the required release strength. At this time the steam curing may be discontinued. The concrete shall remain covered for two hours minimum after steam curing has ceased at which time detensioning shall be accomplished.

Recording thermometers showing the time-temperature relationship shall be furnished at the rate of 1 (25.5 cm) for each 200 feet (61 m) of bed.

604.3 PRE-STRESSING STEEL Pre-stressing steel shall conform to Subsection 201.2.7 and to the following: Wires shall be straightened, if necessary, to produce equal stress in all wires of wire groups or parallel-lay cables that are to be stressed simultaneously, or when necessary to insure proper positioning in the enclosures. When wires are button-headed, the buttons shall be cold formed symmetrically about the axes of the wires, and shall develop the full strength of the wire. No cold forming process shall be used that results in indentations in the wire.

Until finally encased in concrete or grouted in the member, all pre-stressing steel shall be protected against corrosion and damage, and shall be free of all dirt, scale, oil, grease and other deleterious substances. Evidence of mishandling or inadequate protection such as physical damage or development of visible rust or other results of corrosion shall be cause for rejection. No welds or grounds for welding equipment shall be made on any pre-stressing steel. If arc welding is utilized on other parts of a pre-stressed structure, the ground shall be attached directly to the part being welded. All grounding and welding operations performed after the pre-stressing steel has been installed shall be approved by the Engineer.

604.4 ANCHORAGES AND DISTRIBUTION All post-tensioned pre-stressing steel shall be secured at the ends by means of approved permanent anchoring devices. The anchors shall be of such design that they will not kink, neck down, or otherwise damage the pre-stressing steel. The load from the anchoring device shall be distributed to the concrete by means of approved devices that will effectively distribute the load to the concrete. All anchorage devices for post-tensioning shall hold the pre-stressing steel at a load producing stress of not less than 95 percent of the guaranteed minimum tensile strength of the pre-stressing steel.

Where the end of a post-tensioned assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the pre-stressing steel and all parts on the anchor devices will be at least 2 inches (51 mm) inside of the end surface of tee members, unless a greater embedment is shown on the plans. Following post-tensioning, the recesses shall be filled with Class "A" mortar and finished flush.

When headed wires are used, the outside edge of any hole for pre-stressing wire through a stressing washer, or through an unthreaded bearing ring or plate, shall not be less than 1/4 inch (6.4 mm) from the root of the thread of the washer or from the edge of the ring or plate.

Distribution plates or assemblies shall conform to the following requirements:

(1) The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 pounds per square inch (20.69 Mpa), and a suitable grillage of reinforcing steel shall be used in the stressed area.

(2) Bending stresses in the plates or assemblies induced by the pull of the pre-stressing steel shall not exceed the yield point of the material or cause visible distortion in the anchorage plate when 100 percent of the ultimate load is applied.

Should the contractor elect to furnish anchoring devices of a type which are sufficiently large and which are used in conjunction with a steel grillage embedded in the concrete that effectively distributes the compressive stresses to the concrete, the steel distribution plates or assemblies may be omitted.

604.5 DUCT ENCLOSURES. Duct enclosures for pre-stressing steel shall be rigid, mortar tight, accurately placed at plan locations free of angle changes, crimping or flattening. Ducts shall be rigid, galvanized, ferrous metal tubes with either welded or interlocked seams having sufficient strength to maintain correct alignment during placing of concrete. Galvanizing of the welded seam will not be required. Joints between sections shall be positive metallic connections sealed with waterproof tape. Transition couplings connecting ducts to anchoring devices need not be galvanized.

Ducts shall be securely fastened in place to prevent movement during the placement of concrete. Vents shall be ½ inch (12 cm) minimum diameter standard pipe connection at the high points in the duct profile to ducts with metallic structural fasteners sealed with waterproof tape. Ends of vents shall be removed 2 inches (5.1 cm) below the roadway surface after grouting has been completed.

604.6 PRE-STRESSING. All pre-stressing steel shall be tensioned by means of hydraulic jacks. Each jack shall be equipped with an accurate pressure gage with a dial at least 6 inches (152 mm) in diameter, and each jack and its gage shall be accompanied by a recent certified calibration chart acceptable to the Engineer, a reverse calibrated load-cell may be used. Except where the compressive strength of concrete at time of initial pre-stress is specified on the plans, tension shall not be applied or transferred to any member until the concrete in the member has attained 80 percent of the design compressive strength.

The cutting and releasing of pre-stressing steel in pre-tensioned members shall be performed in such an order that the eccentricity of pre-stress will be a minimum. The pre-stressing steel shall be cut off flush with the end of the member and the exposed ends of the pre-stressing steel shall be heavily coated with roofing asphalt, or an approved epoxy.

Post-tensioning will not be permitted until it is demonstrated that the pre-stressing steel is free and unbonded in the enclosure. In addition, prior to placing forms for the closing of box girder cells the contractor shall demonstrate that adjacent ducts are unobstructed. The tensioning process, as applied to post-tensioned members, shall be so conducted that tension being applied and the elongation of the pre-stressing steel may be measured and recorded at all times. The record of gage pressures and elongations shall be submitted to the Engineer for approval.

Pre-stressing steel in post-tensioned members shall be tensioned by simultaneous jacking at both ends of the assembly, except that simple span members may be tensioned by jacking from one end only. Where jacking from one end is permitted, half of the pre-stressing steel in the member shall be stressed from one end and the other half from the opposite end. The loss of stress in pre-tensioned pre-stressing steel due to creep and shrinkage of concrete, creep of steel, and elastic compression of concrete shall be assumed to be 35,000 pounds per square inch (241.3MPa).

Longitudinal pre-stressing steel in pre-tensioned members shall not be cut or released until tests on concrete cylinders indicate that the concrete in the member has attained a compressive strength of not less than the value shown on the plans or the following values, whichever is greater:

Diameter of Strand		Compressive Strength	
Inches	(mm)	(psi)	(MPa)
3/8	(9.5)	3,500	(24.13)
7/16	(11.1)	4,000	(27.58)
1/2	(12.7)	4,000	(27.58)

The working force in the pre-stressing steel shall not be less than the value shown on the plans. Unless otherwise specified or shown on the plans, the average working stress in the pre-stressing steel shall not exceed 60 percent of the ultimate tensile strength of the pre-stressing steel.

604.7 BONDING AND GROUTING. Post-tensioned pre-stressing steel shall be bonded to the concrete by completely filling the entire void space between the duct and the tension with grout placed under pressure.

Grout shall consist of Type II portland cement, water, and a non-shrinking for expansive admixture in compliance with the requirements of Subsection 201.1.5. Re-tempering of grout will not be permitted. Grout shall be continuously agitated until it is pumped.

All ducts shall be clean and free of deleterious materials that would impair bond of the grout or interfere with grouting procedures. Immediately prior to the grouting, each duct shall be thoroughly flushed with water containing 0.1 pound of hydrated lime or quicklime per gallon (.012kg per liter) and then blown out with oil-free air, or cleaned by another method approved by the Engineer.

Grout injection pipes shall be fitted with positive mechanical shutoff valves. Vents and ejecting pipes shall be fitted with valves, caps or other devices capable of withstanding the pumping pressures. Valves and caps shall not be removed or opened until the grout has set. Leakage of grout through anchorage assemblies shall be prevented by mechanical capping or other positive devices capable of withstanding the grouting pressures.

Grout shall be pumped through the duct and continuously wasted at the outlet until 15 seconds after all visible slugs of water or air are ejected. The outlet pipe shall then be closed and the pumping pressure held momentarily.

The valve at the inlet shall then be closed while maintaining this pressure. After post-tensioned pre-stressing steel has been pressure-grouted the members shall not be moved or otherwise disturbed until at least 24 hours have elapsed. The anchorage assemblies shall not be encased in concrete until the duct grouting has been completed and the concrete surfaces against which the encasement is to be placed have been cleaned by abrasive blasting so as to expose the aggregate.

604.8 SAMPLES FOR TESTING. Samples and testing shall conform to the specifications or ASTM A.416, ASTM A-421.

604.8.1 Handling. Extreme care shall be exercised in handling, storing, moving or erecting precast pre-stressed concrete members to avoid twisting, racking, or other distortion that would result in cracking or damage to the members.

Every precast pre-stressed member shall be handled, transported, and erected in an upright position and the points of support and directions of the reactions with respect to the member shall be approximately the same during transportation and storage as when the member is in its final position. After erection the pre-stressed girders shall be

adequately supported and braced until after the concrete of the diaphragms or of other girder bracing members has hardened.

604.9 MEASUREMENT AND PAYMENT. Precast pre-stressed concrete members, except piling, will be paid for at the contract price in the Proposal for furnishing and placing precast pre-stressed concrete members of the various types and lengths.

The contract price paid for furnishing and placing the member shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all work involved in constructing and furnishing the member at the site of the work complete in place as shown on the plans.

Precast pre-stressed concrete piling will be measured and paid for as provided in Section 901.

SECTION 605

CONCRETE CURBS, WALKS, GUTTERS, DRIVEWAYS

605.1 GENERAL. Concrete curbs, gutters, walks, combination curb and gutter, and driveways shall be constructed in accordance with these specifications and in reasonably close conformity with the lines, grades, dimensions indicated on the Drawings or established by the Engineer. Subgrade preparations shall conform to the requirements of Section 401.

605.2 MATERIALS

605.2.1 Portland Cement Concrete. Shall conform to Subsection 201.1, Class A. Concrete for integral curbs shall be either Class A or the same type concrete used in the roadway pavement.

605.2.2 Joint Materials: Shall conform to Subsection 201.3.

605.3 FORMS

605.3.1 Standard Forms. The forms for the curbing or gutter shall be of wood or metal, straight, free from warp and of sufficient strength when staked to resist the pressure of the concrete without springing. All forms shall be cleaned thoroughly and greased or soaped before concrete is placed against them. Forms which have become worn, bent or broken shall not be used until satisfactorily repaired and straightened. Repaired forms shall not be used until inspected and approved by the Engineer. An approved mechanical curb forming machine may be used without forms.

605.3.2 Slip Forms: At the option of the contractor and with the approval of the Engineer, slip form equipment may be used for the construction of concrete curb, gutter and walks. Slip form equipment shall be provided with traveling side and top forms of suitable dimensions, shapes, and strength to support the concrete for a sufficient length of time during placement to produce curb and gutter of the required cross section. The equipment shall spread, consolidate and screen the freshly placed concrete in such a manner as to provide a dense and homogeneous product. The slip form equipment shall have automatic sensor controls which operate from an offset control line. The line and grade of the slip form equipment shall be automatically controlled.

605.4 PLACING CONCRETE. Concrete shall be placed on a subgrade sufficiently dampened to insure that no moisture will be absorbed from the fresh concrete. Concrete shall be placed in curb, gutter, and curb and gutter forms in horizontal layers not exceeding 6 inches (152 mm) in thickness, each layer being spaded along the forms and thoroughly tamped. Concrete may be placed in layers of more than 6 inches (152 mm) in thickness only when authorized by the Engineer and the spading and tamping is sufficient to consolidate the concrete for its entire depth.

After the concrete for walk has been placed, a strike-off shall be used to bring the surface to the proper elevation when compacted. It shall be spaded along the form faces and tamped to assure a dense and compact mass, and to force the larger aggregate down while bringing to the surface not less than 3/8 inch (9 mm) of free mortar for finishing purposes. After the concrete has been placed and tamped, the upper surface shall be struck off to the specified grade.

605.5 JOINTS.

605.5.1 Expansion Joints. Expansion joints shall be constructed in curbs, walk and gutter as shown on the plans or as specified herein. Such joints shall be filled with pre-molded joint filler. No such joints shall be constructed in driveways except as may be approved by the Engineer. One-half inch (13 mm) joints shall be constructed in curb and gutter at the end of all returns. Expansion joint filler 1/4 inch (6 mm) thick shall be placed in walk at round all utility poles which may project into the concrete along the line of the work, and in walk returns between the work and the back of curb returns when required by the Engineer.

Expansion joints shall be provided in curb gutters, walks directly opposite expansion joints of abutting concrete pavement. Where curbs, gutters and walks do not abut concrete pavement, expansion joints, 1/2 inch (12 mm) in width shall be provided at intervals not exceeding 40 ft. (9.7 m). Joint filler strips between walk and curb shall be the depth of the walk with the top set flush with the specified grade of the top of curb.

All expansion joint filler strips shall be installed vertically, and shall extend to the full depth and width of the work in which they are installed, and be constructed perpendicular to straight curb or radially to the lines of the curb constructed on a curve. Expansion joint filler materials shall completely fill these joints to within 1/4 inch (6 mm) of any surface of the concrete. Excess filler material shall be trimmed off to the specified dimension in a neat and workmanlike manner. During the placing of the concrete, the filler strip shall be held rigidly and securely in proper position.

605.5.3 Weakened-Plane Joints. In walks, joints shall be transverse to the line of work and at regular intervals not exceeding the width of the walk. At curves and walk returns, the joints shall be radial. Longitudinal joints shall be placed at mid-point of walks 8 ft. (2.4 m) or more in width. In gutter, including gutter integral with curb, joints shall be at regular intervals not exceeding 10 feet (6.10 m). Where integral curb and gutter is adjacent to concrete pavement, the joints shall be aligned with the pavement joints where practical. Control joints shall be accomplished with a jointer tool having a depth of 1/4 inch (13 mm) and a radius of approximately 1/8 inch (3mm).

605.6 FINISHING. The forms shall be removed within 24 hours after the concrete has been placed, and honeycombed areas and other minor defects shall be filled with mortar composed of portland cement and sand, mixed in the same proportion as provided for the concrete. Plastering will not be permitted on the faces of the curbing or gutter, and all rejected curb, walks or gutter shall be removed and replaced without additional compensation. The top and face of the concrete shall be finished while the concrete is still green by use of wood float, brush and water.

605.7 CURING. After finishing, the concrete shall be cured in accordance with Subsection 601.9.

605.8 DRIVEWAY ENTRANCES. Driveway entrances shall be provided in new curb at all existing driveways along the line of the work, at locations shown on the plans, and at such other locations as may be designated by the Engineer.

605.9 BACKFILLING AND CLEANUP. Backfilling to the finished surface of the newly constructed improvement must be completed before acceptance of the work. Upon completion of the work the surface of the concrete shall be thoroughly cleaned and the site left in a neat and orderly condition.

605.10 MEASUREMENT AND PAYMENT. The quantities of curbs and/or gutters, walks, driveways for payment will be the design lengths as indicated on the drawings. Design quantities will be adjusted if the Engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Unless otherwise

specified, all necessary excavation, backfill, joint materials, reinforcement will be considered incidental to the work and will not be measured for separate payment. When combination curb and gutter is specified, all gutters required in conjunction with catch basins will be included in the design quantities for combination curb and gutter

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
605 (1)	Concrete Curb (Barrier) (Mountable)	Linear Foot
605 (2)	Concrete Gutter	Linear Foot
605 (3)	Combination Curb and Gutter (width and thickness)	Linear Foot
605 (4)	Sidewalks (thickness)	Square Yard
605 (5)	Driveways (thickness)	Square Yard

SECTION 606

CONCRETE REINFORCEMENT

606.1 DESCRIPTION. The extent of concrete reinforcement is shown on the drawings and in schedules. The work includes fabrication and placement of reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties and supports.

606.2 CODES AND STANDARDS. Comply with requirements of the following codes and standards, except as herein modified:

American Welding Society, AWS D12.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."

Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

American Concrete Institute, ACI 318 "Building Code Requirements for Reinforced Concrete."

606.3 SUBMITTALS

606.3.1 Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel to Engineer.

606.3.2 Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement.

606.4 DELIVERY, HANDLING AND STORAGE. Deliver reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

606.5 MATERIALS. All material shall conform to Subsection 201.2.

606.6 FABRICATION. Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice." In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material. Unacceptable Materials: Reinforcement with any of the following defects will not be permitted in the work:

- Bar lengths, depths and bends exceeding CRSI fabrication tolerances.
- Bends or kinks not indicated on drawings or final shop drawings.
- Bars with reduced cross-section due to excessive rusting or other cause.

606.7 INSTALLATION. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete. Accurately position, support, and secure reinforcement against displacement by form work, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

Place reinforcement to obtain the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16 gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lace splices with 16 gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcement bars more than 2" (5.1 cm) beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

606.8 SPLICING. All reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without written approval. Splices shall be staggered as far as possible. Unless shown on the plans, bars shall be lapped 30 bar diameters for Grade 40, or 45 diameters for Grade 60. Construction joints shall not be made within the limits of the lapped bars.

In lapped splices, the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the minimum clear distance to other bars and the minimum distance to the surface of the concrete as specified in Subsection 606.7. Welding of reinforcement steel shall be done only if detailed on the plans or if authorized by the engineer in writing.

606.8.1 Welding: Comply with the requirements of AWS D12.1 for field welding. Prior to field welding, determine the weldability of reinforcing bars by a laboratory chemical analysis of steel. Only steel conforming to the chemical requirements specified in AWS D12.1 may be welded.

606.8.2 Mechanical Butt Splicing. As an alternate to welding, splices may be made by an approved mechanical butt splicing method using a ferrous filler metal with an enclosing steel sleeve or mold. The splice shall develop at least the ultimate stress of reinforcing bars in tension.

Splicing shall be done using a standard, approved exothermic process whereby molten filler metal, contained by a high strength steel sleeve or mold of larger inside diameter than the bars, is introduced into the annular space between bars and sleeve or mold and also between ends of bars.

Upon cooling and hardening of filler metal, the splice shall be capable of transferring the stresses specified from one bar to the other by the mechanical strengths of splice components. The splice shall not depend upon fusion of filler metal with bars nor shall bars be heated to their melting point during the splicing process. Degrees of heat required to effect the splices shall not decrease the structural properties of the bars nor significantly affect the original hardness of bars.

Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories. The process shall be approved by the engineer. Except as otherwise specified, splicing shall be done in accordance with the manufacturer's recommendations.

606.9 MEASUREMENT AND PAYMENT

606.9.1 General: Unless unit prices are indicated in the project proposal for reinforcing steel, all costs in connection with concrete reinforcing steel shall be included in the Bid price for the particular item under which the concrete construction is performed.

606.9.2 Unit Price Method: The quantities of reinforcement for payment will be the design weights as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven or if design changes are necessary.

Design quantities are based on theoretical weights of nominal size plain round bars as follows:

<u>BAR NO.</u>	<u>WEIGHT LBS./LIN. FT.</u>	<u>WEIGHT KG/M</u>
3	0.376	.560
4	0.668	.994
5	1.043	1.552
6	1.502	2.235
7	2.044	3.042
8	2.670	3.973
9	3.400	5.059
10	4.303	6.403
11	5.313	7.906
14	7.650	11.384
18	13.600	20.238

The following will be considered incidental to the work and will not be included in the pay quantities:

- (a) Reinforcement furnished for testing purposes.
- (b) Additional reinforcement used for laps in splices other than those shown on the plans.

(c) Additional weight of reinforcement used at the contractor's request as substitutions for reinforcement shown in the plans.

(d) Spacers, clips, chairs, and other material used in fastening reinforcement in place.

The accepted quantities of reinforcing steel will be paid for at the contract price per pound complete in place.

Item No	Pay Item	Pay Unit
606 (I)	Deformed Reinforcing Steel	Pound

SECTION 607

DRILLED SHAFT FOUNDATIONS

607.1 DESCRIPTION. This work consists of the construction of foundations of reinforced concrete shaft with or without bell type concrete footings. Concrete shafts shall be placed in drilled excavation when the shafts are with bell type footings. Such foundations shall be constructed in accordance with the plan details and these specifications.

607.2 MATERIALS. All concrete shall be Class D conforming to Section 201. Reinforcing steel shall conform to Section 606. The sizes and dimensions shall be as shown on the plans.

607.3 CONSTRUCTION REQUIREMENTS.

607.3.1 Excavation: The Contractor shall perform all excavation required for the shafts and bell footings, through whatever substances encountered and to the dimensions and elevations shown on the plans or required by the site conditions. Unless otherwise shown on the plans, all shafts shall be bored plumb to a tolerance of 1 ½ inches (3.8 cm) for depths up to and including 10 feet (3.1 cm). The center of the drilled shaft at the top shall lie within a 3"inch diameter circle with the center of that circle being the theoretical center of the drilled shaft. When bells are required, they shall be excavated so as to form a bearing area of the size and shape shown on the plans. Shafts and bells may be excavated either by hand or by mechanical methods. Blasting methods shall be used only with permission of the Engineer and when used shall be so conducted as to avoid disturbance of the formations below or outside the limits of the proposed shaft concrete.

The plans indicate the expected depths and elevations at which satisfactory bearing material will be encountered and this information will be used as a basis for the contract. If satisfactory foundation materials are not encountered at plan elevations, the footings may be raised or lowered as determined by the Engineer.

Casings will be required for shaft excavations when necessary to prevent caving of the material or to shut off seepage water. Casings shall be of metal and of ample strength to withstand handling stresses, the pressure of concrete and of the surrounding earth of backfill materials and shall be watertight. The inside diameter of casing shall not be less than the nominal size of shaft; otherwise, the size of casing and the size of drilled excavation in which the casing is to be placed will be left to the discretion of the contractor, except as noted below. No extra compensation will be allowed for the concrete required to fill an oversize casing or oversize excavation.

When the drilling operation reaches a point where caving conditions or excess ground water is encountered, no further drilling will be allowed until a construction method is employed which will prevent any caving that tends to make the excavation appreciably larger than the size of casing to be used. Drilling in a mud slurry without removal of cuttings or other construction methods which will control the size of cuttings or other construction methods which will control the size of excavation will be permitted. The contractor will be required to use a method of construction which will allow completion of the top of the drilled shaft without any intermixing of concrete and drilling mud.

If the elevation of the top of shaft is below ground level at the time of concrete placement, an oversize casing from ground elevation to a point below the top of the shaft will be required to control caving of any material into the freshly placed concrete.

Any excavation for the footing bells or shafts beyond the lines required by the plan dimensions, where casings are not required shall be backfilled with Class D concrete at the contractor's expense. Where casings are used, the contractor will be permitted to backfill around the upper portion of the casing with pea gravel or other granular material. Where a double casing is required for a portion of the shaft, no material shall be placed between the casings, but this area shall be filled with Class D concrete.

Under normal operations when the casing is to be removed, the removal shall not be started until all concrete placement is completed in the shaft. Movement of the casing for short pulls of a few inches or rotating of the casing will be permitted. When unusual conditions warrant, the casing may be pulled in partial stages. A sufficient head of concrete shall be maintained at all times above the bottom of the casing to overcome hydrostatic pressure.

Extraction of the casing shall be at a slow, uniform rate and the pull shall be in a vertical direction. If any upward movement of the concrete or steel inside the casing occurs at any time during the pulling operation, the following criteria shall govern:

(1) If the upward movement is one inch or less, the casing may be left in place and the shaft used if the concrete is vibrated or rodded to reconsolidate the concrete. Vibration or rodding shall not be used to attempt to break the casing loose for extraction unless the entire shaft is to be replaced.

(2) If the upward movement is greater than one inch (25.4 mm), all of the material shall be removed and the entire drilled shaft operation shall be redone.

Drilled shaft concrete shall not be placed under water without permission of the Engineer. If such permission is granted, underwater concrete shall be placed in accordance with Subsection 601.7.7 and limited to placement with a tremie.

Material excavated from shafts and bells and not used in the backfill around the complete bents or piers shall be disposed of as directed. The disposal of such material shall be in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure or other parts of the work. At the time concrete is placed, the excavation shall be free from accumulated seepage water and all loose material shall be removed from the base area. The contractor shall provide suitable access and lighting for the Engineer to inspect the completed foundation excavation and check the dimensions and alignment of drilled shafts and the under-reamed excavation when under-reaming is required.

When the plans require drilled shafts in the end bents, the embankment at the bridge ends shall be made to grade as shown and thoroughly compacted as provided in the governing specifications prior to drilling for end bent shafts.

607.3.2 Reinforcing Steel: The reinforcing steel cage for the shaft consisting of longitudinal bars and spiral hooping or lateral ties shall be completely assembled and placed into the shaft as a unit. Generally, the reinforcing steel unit shall not be placed until immediately before concreting operations are to be started. The longitudinal bars shall be tied or tack-welded to the spiral hooping at intervals not to exceed 12 inches (30.5 cm) on centers to provide a rigid unit.

For cased shafts where the reinforcing steel cage is over 30 feet (9.1 m) in length, the longitudinal bars shall be tied or tack-welded at each intersection of the spiral hooping for a distance of L/5 from the bottom of the cage, where L is the length of the spiral cage. The cage of reinforcing steel shall be supported from the top by some positive method to

prevent slumping downward during extraction of the casing. Dowel bars in the top of the shaft which are not tied together with a cage may be inserted immediately after the completion of the placing of concrete.

In uncased shafts, side spacer blocks of concrete shall be used at intervals along the shaft to insure concentric spacing for the entire length of shaft. In cased shafts concrete spacer blocks shall not be used. Metal chair type spacers shall be placed vertically at intervals around the steel cage to insure concentric spacing inside the casing.

607.3.3 Concrete: The work shall be performed in accordance with Section 601 and the requirements herein. Preferably, concrete shall be placed immediately after all excavation is complete and reinforcing steel placed. Concrete placing shall be continuous from the beginning of placing in the shaft or footing bell to the top of shaft or to construction joints as may be indicated on the plans. Time intervals will be allowed for pulling casings, for placing forms and other operations necessarily carried on in sequence with the placing operations. The reinforcing steel cage shall be held vertical in some manner to restrain the steel from slumping during the concrete placement operation.

Concrete shall be placed through a tremie or approved equal to prevent segregation of concrete materials and unnecessary splashing on the reinforcing steel cage. The tube shall be made in sections to permit the discharge and rising as the placement progresses.

Wherever a casing is used, the casing shall be smooth and well oiled and shall extend sufficiently above the grade of the finished shaft to provide excess concrete to be placed for the anticipated slump due to the casing removal. Where a casing is to be pulled, the concrete placed in casing shall be of such workability as to require no vibrating or rodding.

Where a cap block or groundline strut is shown on the plans to be placed at the top of the drilled shaft and the cap or strut is shown to be monolithic with the drilled shaft, a time interval will be allowed for placing the required form and reinforcing after any necessary casing removal. When the drilled shaft is continued by means of a column, the contractor must make provisions for adequately holding the column form at the top of the drilled shafts either by means of inserts or by forming and pouring a stub the size of the column. After a concrete pour is completed, the top surface shall be cured and any construction joint area shall be treated as specified in Section 601.

607.4 TEST HOLES. When shown on the plans or when ordered by the Engineer in writing, test holes will be required to establish elevation for "belling" to determine elevation of ground water or to determine soil characteristics. The diameter and depth of test hole or holes shall be as shown on the plans or as directed by the Engineer.

607.5 TEST BELLS. When shown on the plans or when ordered by the Engineer in writing, under-reaming of bells on specified test holes will be required to establish the ability to under-ream in the soil strata present. The diameter and shape of the test bell shall be as shown on the plans or as directed by the Engineer.

607.6 METHOD OF MEASUREMENT. Acceptable drilled shafts in place of the specified diameter will be measured by the linear foot. At interior bents and piers, shafts will be measured from a point 6 inches (15.2 cm) below the ground elevation at the center of shaft after clearing operations are completed unless otherwise indicated on the plans. At highway grade separations and at railroad underpasses, the ground elevation will be the completed roadway section under the structure. At stream crossings and at railroad overpasses, the ground elevation will be the elevation existing at the time drilling begins. At abutment bents the length of shaft will be measured from the bottom of cap elevation.

Footing bells, constructed to the specified dimensions or to the altered dimension as authorized by the Engineer, will be

measured by the cubic yard of concrete in the acceptable footings placed. The bell shall consist of the authorized footing volume outside the dimensions of the drilled shaft, which for the purpose of measurement will be considered as extending to the bottom of the bell. Test holes of the specified diameter will be measured from the elevation of the ground at the time drilling begins by linear foot of acceptable test hole drilled. Test bells of the specified diameter and shape will be measured by each test bell acceptably under-reamed.

607.7 BASIS OF PAYMENT. The accepted quantities of drilled shafts will be paid for at the contract unit price per linear foot, subject to the following limitations for overruns authorized by the Engineer.

- (a) Payment for individual completed shaft lengths will be made at the contract unit price per linear foot.
- (b) For extra depth drilling the maximum plan length shaft will be considered to be maximum length shaft.
- (c) Footing bells, constructed to the specified dimensions or to the altered dimensions as authorized by the Engineer, will be paid for at the contract unit price per cubic yard.
- (d) Test holes of the specified diameter will be paid for at the contract unit price per linear foot.
- (e) Test bells of the specified diameter will be paid for at the contract unit price per each.

The foregoing unit prices shall be full compensation for making all excavations, for drilling all test holes and test bells, doing any necessary pumping, placing and removing any required casings, furnishing and placing all concrete and reinforcing steel except as noted below and all backfilling. Where the bottom of drilled shaft is ordered to be placed at an elevation below plan grade and a splice of reinforcement is required, payment will be made at the contract unit price per pound for "Reinforcing Steel" for the extra reinforcement required to make one 20-diameter lap splice per bar. No extra payment will be made for casings left in place.

Item No	Pay Item	Pay Unit
607(1)	Drilled Shaft (Diameter)	Linear Foot
607(2)	Bell Footing	Cubic Yard
607(3)	Test Hole (Diameter)	Linear Foot
607(4)	Test Bell (Diameter)	Each

SECTION 608

DITCH PAVING AND CONCRETE REVETMENT

608.1 GENERAL. This work shall consist of furnishing and placing concrete for paving ditches and revetment complete.

608.2 MATERIALS.

- (a) Concrete for ditch paving and concrete revetment shall be Class A 3800 psi as specified in Subsection 201.1.
- (b) Geotextile Fabric shall be as specified in Subsection 211.1.
- (c) Wet-Batched Sacked Concrete shall be Class R concrete complying with Section 201. Concrete shall be wet-batched prior to placement in sacks, and sacked concrete shall be immediately placed in the revetment after batching. Mixing water for concrete shall be added as required to produce a slump of 4 inches to 6 inches (100 mm to 150 mm).
- (d) Dry-Batched Prepackaged Sacked Concrete: Prepackaged concrete shall be an approved product and shall consist of one part cement and a maximum of 5 parts sand by weight (mass) or other approved mix with the same cement content, and shall be dry mixed until uniform in color.

(1) Cement: Cement shall be in accordance with Subsection 201.

(2) Aggregate: Aggregates shall comply with the gradation requirements of Subsection 200.1.2 Mortar Sand.

(3) Sacks: Sacks shall be burlap and shall comply with AASHTO M 182 and shall be capable of holding the concrete mixture without leakage during handling.

(4) Water: Water shall be from an approved source in accordance with Subsection 201.1.4.

608.3 PROCEDURES. Construction procedures for concrete ditch paving and revetments shall be constructed in dry or dewatered areas, unless otherwise directed. Logs, stumps and other undesirable material shall be removed from areas on which revetments are to be placed. Usable soil shall be used to bring areas to grade and shall be compacted to the density of surrounding ground to the engineer's satisfaction before final grading. The revetment areas shall be graded to required sections shall be in accordance with applicable portions of Section 601, including but not limited to placing, curing and finishing. Surface finish shall be Class I. All joints and exposed edges shall be edged to 1/4 inch radius. Backfill behind walls shall be water soaked, and all settlement shall be corrected.

- (a) Geotextile Fabric Placement: Ends of geotextile fabric shall be buried for anchorage as shown on the plans. Adjacent strips of geotextile fabric shall be lapped at least 18 inches (450 mm). The laps shall be pinned at maximum 5-foot (1.5 m) intervals. Geotextile fabric shall not be damaged during revetment placement. Damaged fabric shall be repaired or replaced.
- (b) Wet-Batched Sacked Concrete Placement: Sacks shall be uniformly filled to approximately 3/4 cubic foot (0.02 cu m). The open end shall be folded under the bag during placement. Sacks of wet-batched concrete shall be placed in one layer in contact with adjacent sacks and tamped into position by approved methods. Placement of sacked concrete shall begin at the revetment toe and progress

upslope. Sacked concrete revetment for stream channels and other relatively level areas shall be placed as directed.

- (c) **Dry-Batched Prepackaged Concrete Placement:** Sacks shall be uniformly filled to approximately 3/4 cubic foot (0.02 cu m), and the ends shall be sealed by tying, stitching or other approved methods. The filled sacks shall be tightly packed against each other. Placement shall begin at the revetment toe and progress upslope with staggered joints. At the end of each day's operations and upon completion at a location, the sacks and contents shall be saturated with water to the satisfaction of the engineer. The quantity of water required shall be as directed at no direct pay.

608.4 MEASUREMENT. Ditch paving and revetment will be measured by the square yard determined by the net area of completed and accepted paving. Grade beams and toe walls will not be measured for separate payment.

608.5 PAYMENT. The number of units placed and accepted shall be paid for at the contract unit price per unit for 4" concrete ditch paving and 4" concrete revetment. Payment shall constitute full compensation for preparation of slopes, excavation, backfilling, grade beams, toe walls, reinforcing, dowels, joint fillers for furnishing all materials, equipment, tools, labor and incidentals, and the performance of all work necessary to complete the item.

Item No	Pay Item	Pay Unit
608(1)	4" concrete ditch paving	Square Yard
608(2)	4" concrete revetment	Square Yard
608(3)	Sacked Revetment	Square Yard

SECTION 609

RAISING, VOID FILLING, AND UNDERSEALING PAVEMENTS USING POLYURETHANE

609.1 DESCRIPTION

609.1.1 This work shall consist of raising, filling voids, and undersealing existing cementitious and asphalt pavements at locations as indicated on Contract Work Orders or as directed by the Project Engineer, through implementation of the process described in Section 609.2 using polyurethane materials as described in Section 609.3.

609.1.2 The Contractor shall have a minimum of 4 years experience lifting concrete pavement, utilizing the process described in Section 609.2 and using polyurethane materials as described in Section 609.3.

609.2 PROCESS

609.2.1 The Contractor shall provide for all equipment, materials, labor, and supervision required for the work. The Owner will provide on-site inspection personnel and engineering oversight for any special project conditions and specific project.

609.2.2 The Contractor shall, at a minimum, provide the following equipment for such projects:

1. A truck-mounted pumping unit capable of injecting the high density polyurethane formulation beneath the pavements and controlling the volume of injected material along with the rate and magnitude of pavement lifting, if required.
2. Pressure and temperature control devices to assure and maintain proper temperature and proportionate mixing of the polyurethane component materials. All necessary electric generators, compressors, heaters, hoses, containers, valves and gauges to efficiently conduct and control the project work.
3. Pneumatic and electric drills capable of efficiently drilling 14-mm to 18-mm diameter injection holes through pavements up to one (1) meter thick.
4. Suitable laser levels and/or dial indicator devices, used to insure that the pavement is raised to an even plane and to the required elevation.

609.2.3 A pavement profile from laser level readings or string lines shall be used to determine where the pavement needs to be raised.

609.2.4 In the project area, a series of 14-mm to 18-mm diameter holes shall be drilled through the pavement and underlying base to an appropriate depth as determined by the Contractor. Care shall be taken to protect the pavement surrounding each hole from damage.

609.2.5 The material shall be injected through the drilled holes until all known or encountered voids under the pavement are filled. The rate and amount of material injection shall be determined by the Contractor.

609.2.6 The Contractor shall be responsible for any pavement blowouts or excessive pavement lifting which may occur as a result of his work and shall repair the subject area to the satisfaction of the Project Engineer without additional cost.

609.2.7 Corrections to the grade of adjacent slab, if necessary and as determined by the Project Engineer, shall be made in the same manner that is required for pavement that is raised. All raised pavements must match the existing grade or adjacent slabs that provide positive drainage. Final elevations shall be within 7-mm of the required elevations as determined by the profile of the Project Engineer.

609.2.8 The Contractor's injection nozzles shall prevent leakage during injection and shall be removed at completion or driven into the injection hole to a depth of 3.0 cm below the pavement surface. Holes shall be filled to the pavement surface with polyurethane material and a non-shrink grout.

609.2.9 At the end of each work shift, the work area shall be left in a clean, swept, and neat condition.

609.3 POLYURETHANE MATERIAL

The material used for raising and undersealing pavements shall be a water blown, closed cell, high density polyurethane system.

The material shall have a free rise minimum density of 48 kilograms per cubic meter (3.0 lbs./cubic ft.) and a minimum compressive strength of 40 PSI.

The material shall be hydrophobic in its component reaction so that the injected product is not significantly compromised by soil moisture or free water under the pavement.

The high density polyurethane formulation shall reach 90% of full compressive strength within 15 minutes from the time of injection.

609.4 TESTING AND DATA

609.4.1 In advance of contract work commencement, the Contractor shall provide to the Contract Administrator and/or the Project Engineer the following:

- a. Material Safety Data Sheets for all pertinent materials.
- b. A Certificate of Compliance from the manufacturer of the polyurethane component materials to be used. The certification shall include the results of density and compressive strength analysis performed in accordance with ASTM D 1622 and ASTM D 1621 respectively.
- c. A report from an Industrial Hygienist who has conducted a personnel, production vehicle, and typical job-site safety review of the Contractor's implementation procedures involving the polyurethane component chemicals.

- d. A satisfactory test, witnessed by the Project Engineer, of injection of the Contractor's polyurethane material into a 40-gallon container of ambient (70°F) temperature water. The resulting product shall demonstrate consistent closed cell polyurethane material. A list of 50 clients for which the Contractor has successfully completed polyurethane raising and/or undersealing pavement projects. The listing shall also contain contact names and phone numbers for the clients involved.

- e. A copy of the Contractor's Employee Safety Manual specific to polyurethane pavement raising and undersealing work.

609.5 MEASUREMENT AND PAYMENT

- 609.5.1** Payment for all work done shall be determined by the Project Engineer and the contract. The Contractor shall be paid per pound of material injected based upon the contract unit price.
- 609.5.2** The quoted price and payment shall include full compensation for furnishing all labor, supervision, materials, tools, equipment, and incidentals for all work as called for in this specification, or as directed by the Project Engineer.
- 609.5.3** At the request of the inspector, all pumping units in service shall perform a product density test by injecting a sample of the unit's polyurethane material into a test cylinder of known volume. The sample's net weight and density result shall be witnessed by the inspector or the Project Engineer. The density shall not be less than the requirement of section 3.2 above.
- 609.5.4** The Owner may test the contents and quality of the polyurethane at the Owner's expense at any time.
- 609.5.5** Daily material usage shall be attested by the inspector and the Contractor and reported on a field production report.

ITEM NO	PAY ITEM	PAY UNIT
609.1	Polyurethane Material	Lbs

PART 7

MASONRY CONSTRUCTION

SECTION 701

CONCRETE MASONRY UNIT CONSTRUCTION

701.1 MATERIALS. All materials for concrete masonry shall conform to the requirements of Subsection 202.2.

701.2 CONSTRUCTION. All masonry walls shall be laid true, level, and plumb in accordance with the plans. Masonry units shall be cured, dry, and surfaces shall be clean when laid in the walls. During construction, all partially laid walls as well as units in storage shall be protected from moisture. All concrete block units and any partially laid walls which become wet during the construction shall be permitted to dry for at least one week, or longer if required by weather conditions, before recommencing work.

Proper masonry units shall be used to provide for all windows, doors, bond beams, lintels, pilasters, etc. with a minimum of unit cutting. Where masonry unit cutting is necessary, all cuts shall be neat and regular and edges exposed in the finished work shall be cut with a power driven abrasive saw. Where no bond pattern is shown, the wall shall be laid up in straight uniform course with regular running bond with alternate header joints in vertical alignment. Intersecting masonry walls and partitions shall be bonded by the use of 1/4 inch (6 mm) minimum diameter steel ties at 24 inches (610 mm) on centers (maximum).

Mortar joints shall be straight, clean and uniform in thickness. Unless otherwise specified or detailed on the plans, horizontal and vertical joints shall be approximately 3/8 inch (9 mm) thick with full mortar coverage on the face shells and on the webs surrounding cells to be filled. Units shall be laid with "push joints". No slushing or grouting of a joint will be permitted, nor shall a joint be made by working in mortar after the units have been laid. Exposed walls shall have joints tooled with a round bar (or V-shaped bar) to produce a dense, slightly concave surface well bonded to the block at the edges.

701.2.1 Placing Reinforcing Steel: Reinforcing steel shall be placed as indicated on the plans. Splices shall be lapped a minimum of 40 diameters, except that dowels other than column dowels need be lapped only 30 diameters. Column dowels shall lap 50 diameters. Outside horizontal steel shall lap around corners 40 diameters and be carried through columns unless otherwise shown on the plans. Inside horizontal steel shall extend as far as possible and bend into corner core. A dowel shall be provided in the foundation for each vertical bar. Vertical cores containing steel shall be filled solid with grout, and thoroughly rodded.

701.2.2 Protection and Curing: During construction operations all adjoining work shall be protected from mortar droppings. Concrete block masonry shall be protected from the sun and rain. When approved in advance by the Engineer, completed masonry construction may be protected with a curing compound. Except in hot weather when it may be fog-sprayed sufficient to dampen the surface, finished concrete block masonry shall not be wetted.

701.3 MEASUREMENT AND PAYMENT. Payment for CMU masonry shall be as specified in the Proposal and the price bid shall include full compensation for furnishing all labor, materials, tools, and equipment and performing all work involved in constructing such concrete masonry in place as shown on the plans. If no separate item is indicated

in the proposal for CMU masonry all costs in connection therewith shall be included in the Bid price for the particular item under which the CMU construction is performed.

Item No	Pay Item	Pay Unit
701(1)	6" Concrete Masonry Units	Square Yard
701(2)	8" Concrete Masonry Units	Square Yard
701(3)	12" Concrete Masonry Units	Square Yard

SECTION 702

BRICK MASONRY

702.1 MATERIALS. All materials for brick masonry shall conform to the appropriate requirements of Subsection 202.1.

702.2 BRICKLAYING. Brick shall be clean, wetted immediately before laying and shall be laid on a full mortar bed with "push joints". In no event will slushing or grouting of a joint be permitted, nor shall a joint be made by working-in mortar after the brick has been laid. Joints between courses of bricks shall be of a uniform thickness of 3/8 inch (9mm) as nearly as possible. Joints on surfaces which are not to be plastered, or on any surface that will be exposed upon completion of the work, shall be neatly struck and pointed. In all cases, the work shall be well-bonded, and if new work is to be joined to the existing or unfinished work, the contact surfaces of the latter shall first be properly cleaned and moistened.

Brick work shall not be constructed upon a concrete foundation until at least 24 hours after such foundation has been placed. No brick shall be laid in water nor shall water be permitted to stand or run on any brick work until the mortar has thoroughly set.

702.3 METHOD OF MEASUREMENT. Brick manholes drop inlets and cleanouts both new and adjusted will be measured by the unit. Excavation required for installation of these units will be considered incidental to the work and will not be measured for separate payment. Design quantities will be adjusted if the Engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. The design volumes are based on the plan depths of the structure and vertical planes 18 inches (46 cm) outside of and parallel to the neat lines of the structure as indicated on the Drawings.

702.4 BASIS OF PAYMENT.

702.4.1 Brick Masonry: All costs in connection with brick masonry construction shall be included in the bid price for the particular item under which the brick construction is performed.

SECTION 703

MECHANICALLY STABILIZED EARTH WALL WITH MASONRY UNIT

703.1 **GENERAL.** This section includes providing mechanically stabilized earth wall system consisting of the following:

- Interlocking masonry units
- Connecting pins and clips
- Geogrid reinforcing
- Gravel backfill and infill
- Sand base
- Select soil
- Color

703.1.1 **Optional Construction.** At contractors' option, the mechanically stabilized earth wall system may be constructed with masonry units or with precast concrete panel units as specified herein this section.

703.1.2 **Related Sections.**

- Earthwork - Section 308
- Storm Drainage - Section 1001

703.1.2.1 **References.** Applicable reference portions of the "Shreveport Standard Specifications for Streets and Storm Drainage Water and Sewerage" 1994 Edition (as amended).

703.1.3 **Submittals.**

Shop Drawings and Design Data. Prior to fabrication, submit shop drawings and design calculations in accordance with these specifications. Shop drawings shall include the horizontal and vertical alignment of the walls as well as the existing and proposed ground lines, as shown in the contract drawings. The shop drawings shall also indicate **all** information needed to fabricate and erect the walls including the elevation; the shape and dimensions of units; the physical characteristics of the geogrid; the dimensions of structural backfill required; and any additional details necessary pertaining to coping, railing, drainage or electrical conduit as required by the contract plans.

Laboratory Test. Prior to delivery of earth and fill materials to job site, submit laboratory test reports on the material for approval.

703.1.4 **Quality Assurance.**

Erection Qualifications. The wall system manufacturer shall provide onsite training and supervision of erection crew prior to and during the construction of the wall. This requirement may be waived by the engineer if the contractor submits written evidence of the erection crew having satisfactory erection experience of the wall system.

703.1.5 **Delivery, Storage and Handling.** Units shall be handled, stored and shipped in such a manner as to eliminate chipping, cracks, fractures and soilings. Prevent mud, cement and similar materials which may deface the units

from coming into contact with the units. Damaged or defaced units shall not be used in the project.

703.2 PRODUCTS.

703.2.1 Manufacturers. The following manufacturers are approved to design and supply the mechanically stabilized earth wall system subject to compliance with contract documents: Allan Block Corp., Edina, MN; Keystone Retaining Wall System, Minneapolis, MN; and Versa-Lok Retaining Wall Systems, N. St. Paul, MN.

703.2.2 Concrete Masonry Units. Conform to ASTM C-90 with hollow cores as modified on the drawings and hereafter. Minimum compressive strength shall be 3000 psi at 28 days. Maximum absorption rate shall be 6 percent. Exposed surfaces shall be manufacturers standard texture; e.g. split-face. Unit design shall facilitate interlocking of units with connecting pins. Design shall permit a set back space per course of wall height. Set back space shall be the same for each course and as recommended by the manufacturer of the units. Unit size and shape shall be as standard with the manufacturer. Provide solid cap blocks.

703.2.3 Connecting Pins. Fabricate from polyester resin/protruded fiberglass, nylon or hot dipped galvanized steel as per ASTM A-525. Size shall be as standard with the manufacturer.

703.2.4 Geogrid. Synthetic interwoven mesh or polyester, high density polyethylene fabricated for use as a soil reinforcement. Fabrics shall have the following minimum property values for the various types indicated on drawings:

TYPE 10T

TEST

Property	Unit	Test Method	Value	
			Warp	Fill
Design Load	lb/ft	GRI G G-4*	2600	1050
Tensile Strength	lb/ft	ASTM D 4595	6800	2850
Open Area	%	COE Method	60	
Ph Resistance	-	-	2-12	

TYPE 5T

TEST

Property	Unit	Test Method	Value	
			Warp	Fill
Design Load	lb/ft	GRI G G-4*	1050	640
Tensile Strength	lb/ft	ASTM D 4595	2650	1600
Retained Modules	lb/ft	LTAL 1000 hrs	21000	125000

*Geosynthetic Research Institute Test Method

Acceptable manufacturers of the geogrid are Mirafi, Inc., Tensar Corp., Conwed Plastics, or approved equivalent.

703.2.5 Gravel

Location. Core fill and wall backfill.

General. Crushed stone or coarse gravel, 3/8 in. to 3/4 in., no more than 5 percent shall pass the 200 sieve with a maximum size of 3/4 in. Gradation shall be approved by the engineer.

703.2.6 Granular Infill

Location. Fill material within the zone of the geogrid reinforcement layers extending from the gravel back-fill to the limits of the geogrid.

General. Clean, free-draining earth material free from organic matter, sticks, branches, roots and other debris. Material shall conform to the following gradation limits:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING</u>
3 inches	100
No. 40	0-60
No. 100	0-5

703.2.7 Sand Base. Soil material conforming to AASHTO M-145, any one of the following types:
A-1 -a, A-1 -b, A-2-4, A-3.

703.2.8 Select Fill. As specified in Section 305.

703.2.9 Erosion Control Matting. As specified in Section 212.

703.2.10 Color. The color selection for the masonry block wall shall be as specified on the plans.

703.4 EXECUTION.

703.4.1 General Installation. Installation shall be in accordance with manufacturer's written instructions. Excavation and earthwork shall be as specified in Section 308 and as detailed compaction of earth beneath wall base shall be to 95 percent as specified in Section 308.

703.4.2 Unit installation. Place units individually as indicated. Insure that units are in full contact with base. Install fiberglass connecting pins and fill units. Tamp fill. Sweep all excess material from top of units and install next course. Insure each course is completely filled prior to proceeding to next course. Lay up each course insuring that pins protrude into adjoining courses a minimum of one inch. Two pins are required per unit. At the end of each course where the wall changes elevation, units shall be turned into the backfill.

703.4.3 Geogrid Installation. The geogrid soil reinforcement shall be laid horizontally on compacted backfill, connected to the concrete wall units and embedded a minimum of 12 inches. Hook grid over fiberglass pins, pull taut and anchor before backfill is placed on the geogrid. Slack in the geogrid at the wall unit connections shall be removed. Geogrid shall be laid at the proper elevation and orientation. Geogrid may be secured-in-place with staples, pins, sand bags or backfill.

703.4.4 Overlaps.

1. Uniaxial geogrid does not need to be overlapped in the across-the-roll direction, except to contain the fill at the slope face when wrap-around facing is used. Uniaxial geogrid shall be overlapped a minimum of 48 inches in the roll direction or as directed by the engineer.
2. Biaxial geogrid shall be overlapped a minimum of 6 inches along the edge parallel too the direction of the reinforcement.
3. Biaxial geogrid shall be overlapped a minimum of 18 inches along edges perpendicular to the direction of reinforcement or as directed.
4. A layer of soil a minimum of 4 inches in thickness shall be spread between uniaxial geogrid layers in the area to be overlapped or as directed.

703.4.5 Placement of Backfill. Wall fill material shall be placed in 8 inch lifts maximum and compacted to 95 percent of standard proctor, or as shown on plans. Compaction test requirements shall be as specified in Section 308. Backfill shall be placed, spread, and compacted in such a manner that minimizes the development of wrinkles and/or movement of the geogrid. Only hand-operated compaction equipment shall be allowed within 3 feet of the wall face.

Backfill shall be placed from the wall outward to insure that the geogrid remains taut. Tracked construction equipment shall not be operated directly on the geogrid. A minimum backfill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds, less than 10 MPH. Sudden braking and sharp turning shall be avoided.

703.4.6 Installation of Erosion Control Matting. As specified in Section 310.

703.5. MEASUREMENT AND PAYMENT. The quantities of mechanically stabilized earth wall system for payment will be the design lengths as shown on the drawings by the square foot on the front face. Design quantities will be adjusted if the Engineer makes change to adjust to field conditions, if plan errors are proven, or if design changes are made. Unless otherwise specified, all necessary excavation, interlocking masonry units, connecting pins and clips, geogrid reinforcing, gravel backfill and infill, sand base, select soil, color, joint materials, reinforcement, equipment and labor will be considered incidental to the work and will not be measured for separate payment. Measurement for the wall cap shall be along the top of the wall cap and shall include full compensation for furnishing all labor, materials, reinforcing steel, tools and equipment and doing all work required to construct the structure in conformity with the plans and specifications.

Payment will be made under the following items:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
703(1)	Mechanically Stabilized Wall	Square Foot
703(2)	Wall Cap	Lin Ft.

PART 8

METAL FABRICATION AND CONSTRUCTION

SECTION 801

STRUCTURAL STEEL

801.1 GENERAL

801.1.1 Shop Drawings. The contractor shall, in accordance with Division I of these standard specifications, submit shop drawings which show details, dimensions, sizes of material and all information and data necessary for the fabrication of the metal work, including full details of the match markings.

801.1.2 Methods and Equipment. When requested before starting erection of any structural members, the contractor shall inform the Engineer fully as to the methods it proposes to follow and the amount and character of equipment proposed for use in such work. The use of such methods and equipment shall be subject to the approval of the Engineer, but this approval shall not be considered as relieving the contractor of the responsibility for the safety of his methods or equipment, or for carrying out the work in full accordance with the plans and specifications.

801.1.3 Standardizing Organizations. Fabrication and erection of structures shall conform to "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction (AISC), except for any conflicts with the applicable building code which may exist, and except that the following sections are considered as excluded from the AISC specifications:

(1)	Section 1.1	Plans and Drawings
(2)	Section 1.4	Material
(3)	Section 1.24	Shop Painting
(4)	Section 1.26	Inspection

The subject matter excluded from the foregoing AISC specifications shall be superseded by the applicable provisions of these Standard Specifications. In addition to complying with AISC specifications, when work involving the use of high strength bolts is included in the project, the design and construction of such work shall conform to ASTM A-325. The design, fabrication and erection of structural steel and all similar work incidental or appurtenant to steel construction for highway bridges shall be performed and accomplished in accordance with the latest Standard Specifications for Highway Bridges adopted by the American Association of State Highway Officials.

801.2 MATERIALS. Structural steel, rivets, bolts, pins and anchor bolts shall conform to applicable provisions of Subsections 207.1, 207.2, and 207.3.

801.3 INSPECTION. An inspector or other authorized representative of the Engineer or City will examine the metals and small items to be fabricated before they are worked in the shop and may exercise constant surveillance over the work during its progress, with full power to reject all materials or workmanship not conforming to the plans and specifications.

The contractor shall give the Engineer 5 days minimum advance notice before commencement of the fabricating operations to permit ample time for the inspection of the materials. The Engineer shall be furnished complete copies of all mill reports prior to commencing fabrication. The contractor shall furnish ample means and assistance for sampling all materials. Arrangements shall be made for the Engineer to have free access at all times to any portion of the workshops where work is being done under these specifications. No fabricating, machining, cutting, welding, assembling, or painting shall be done except with the knowledge of the Engineer. Any work done otherwise will be subject to rejection.

The acceptance of any material or finished member by the Engineer shall not be a bar to subsequent rejection if it is later found to be defective. Rejected material and workmanship shall be promptly repaired or replaced by the contractor.

801.4 WORKMANSHIP. Workmanship and finish shall be equal to the best general practice in modern steel fabricating shops. Before being laid out or worked, rolled material shall be straight. If straightening is necessary, it shall be done by methods approved by the Engineer. Kinks and bends in the material will be cause for rejection. Heat shrinking of low alloy structural steels will not be permitted. If straightening is necessary in the field, only methods approved by the Engineer shall be used. Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting, and chipping shall be done carefully and accurately. Undercut gusset plates will not be accepted. All sharp corners and edges, and edges that are marred, cut, or roughened in handling or erection, shall be slightly rounded by grinding or other suitable means.

801.5 HOLES FOR BOLTS OR RIVETS.

801.5.1 General. Holes shall be either punched full size, punched and reamed, or drilled. The finished hole shall be 1/16 inch (1.6 mm) larger than the nominal diameter of the rivet. Holes punched full size shall have all burrs and sharp edges removed. The diameter of the die shall not exceed that of the punch by more than 3/32 inch (2.4 mm).

801.5.2 Shop Rivets. Holes for shop rivets shall be subpunched, or subdrilled at the fabricator's option, 1/4 inch (6 mm) less in diameter than that of the finished holes, and shall be reamed to size with the parts assembled, with the following exceptions:

- (a) Holes in material thicker than 7/8 inch (22 mm) shall not be punched; however, at the fabricator's option, they may be subdrilled to the diameter specified for subpunching or may be drilled full-size with the parts assembled, provided that the parts are adequately bolted or clamped together.
- (b) Holes in rolled beams and plate girders, including stiffeners and active fillers at bearing points, may be subpunched 1/8 inch (3 mm) less in diameter than that of the finished holes, and reamed to size (after assembly) in material not thicker than the nominal diameter of the rivet less 1/8 inch (3 mm).
- (c) Holes in material not more than 7/8 inch (22 mm) thick, for rivets which do not transfer stress caused by external vertical loading may be punched full-size or, at the fabricator's option, may be subpunched 1/8 inch (3 mm) less in diameter than the finished holes and reamed to size after assembly. This applies to holes for stitch rivets, lateral, longitudinal or sway bracing and their connecting material, lacing, stay plates, diaphragms which do not transfer shear or stress, inactive fillers, and stiffeners not at bearing points. However, holes through

assembled material shall not pass through both reamed plies and plies punched full-size unless the reamed holes have been subpunched for the fabricator's convenience, or the assembled material is not over 5 plies thick, of which the main material consists of not more than 3 plies.

801.5.3 Field Rivets. Holes for field rivets shall be subpunched or subdrilled at the fabricator's option, 1/4 inch (6 mm) less in diameter than that of the finished holes, and shall be reamed to size through steel templates with hardened steel bushings, unless otherwise designated in Project Specifications.

801.5.4 Reamed Work. Reaming shall be done after the pieces forming a buildup member are assembled and so firmly bolted together that the surfaces are in close contact. Burrs and sharp edges of each reamed hole under both rivet heads shall be removed with a countersinking tool making 1/16 inch (1.6 mm) fillets. The pieces shall be taken apart before riveting, if necessary, and any shavings removed. If it is necessary to take the members apart for shipping or handling, the pieces reamed together shall be so marked that they may be reassembled in the same position. Reamed parts shall not be interchanged.

801.5.5 Drilled Holes. Drilled holes shall be 1/16 inch (1.6 mm) larger than the nominal diameter of the rivet. Burrs shall be removed with a countersinking tool making a 1/16-inch (1.6 mm) fillet. Burrs on the outside surfaces shall be removed. If members are drilled while assembled, the parts shall be held securely together while the drilling is being done. Drilled holes shall be drilled to finish size while all of the thicknesses of metal are assembled, or subdrilled and reamed as required for punched-and-reamed holes. Holes shall be clean cut, without torn or ragged edges. Holes that must be enlarged to admit rivets shall be reamed. Drilling shall be done accurately.

801.6 ASSEMBLING STEEL.

(a) General. Steel parts shall be assembled in the shop or in the field in accordance with Subsection 801.6 (b) and 801.6 (c).

(b) Shop Work. At the time of assembling and riveting, bolting, or welding steel surfaces in contact for shop or field connection shall be thoroughly cleaned of rust, loose mill scale, dirt, grease, or other material foreign to the steel. No paint shall be applied to contact surfaces prior to riveting, bolting or welding.

Riveting or bolted trusses, continuous plate girder and I-beam spans, skew portals, skew connections, rigid frames, bents, and towers, shall be completely assembled in the shop and accurately adjusted to line and camber. Holes for field connections shall be completely assembled in the shop and accurately adjusted to line and camber. Holes for field connections shall be drilled or reamed while assembled. Holes for other connections, except those in lateral, longitudinal, and sway bracing, shall be drilled or reamed in the shop with the connecting parts assembled, or drilled or reamed to a metal template with hardened bushings, without assembling.

Long span truss work shall be assembled in lengths of not less than three abutting panels, the members adjusted for line and camber, and holes for field connections drilled or reamed while assembled. Field riveted or bolted joints for girders shall be completely assembled, the members adjusted for line and camber, and holes for field connections drilled or reamed while assembled. Field butt joints for welded girders shall be completely assembled with the members adjusted for line and camber and prepared to fit for welding. All machinery shall be completely assembled. All bearings shall be fitted to the specified clearances and alignment. Gear reductions and all line gears shall have gear center distances set and the gears properly match-marked.

- (c) **Field Work.** The parts shall be accurately assembled as shown on the plans and all match-marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering which will injure or distort the members shall not be permitted. Bearing surfaces to be in permanent contact shall be cleaned before the members are assembled. Unless erected by the cantilever method, truss spans shall be erected on blocking so placed as to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully riveted or bolted and all other truss connections pinned and bolted. Rivets or bolts in splices of butt joints of compression members and rivets or bolts in railings shall not be driven or torqued until the span has been erected in place, temporarily bolted, and the member is supporting its own weight. Splices and field connections shall have half of the holes filled with bolts and cylindrical erection pins (in approximately equal members) before riveting or bolting.

Splices and connections carrying traffic during erection shall have 3/4 of the holes so filled. Fitting-up bolts shall be of the same nominal diameter as the rivets, and cylindrical erection pins shall be 1/32 inch (1 mm) larger. The drifting done during assembling shall be only scale, and other adhering matter. When driven, they shall completely fill the holes. The heads shall such as to bring the parts into position, and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the rivets, they shall be reamed. Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be match-marked, and a diagram showing such marks shall be furnished to the Engineer.

801.7 RIVETING.

- (a) **Shop Work.** Rivets shall be heated uniformly to a light cherry-red color and shall be driven while hot. Rivets, when heated and ready for driving, shall be free from slag, be of approved shape, full size, neatly formed, concentric with the shank, free from fins, and in full contact with the surface of the member.

Loose, burned, or otherwise defective rivets shall be replaced. In removing rivets, care shall be taken not to injure the adjacent metal. Calking or recapping will not be permitted. Rivets shall be driven by direct-acting riveters where practicable. If rivets are driven with a pneumatic hammer, a pneumatic buckler shall be used if practicable.

- (b) **Field Work.** Pneumatic hammers shall be used for field riveting. Connections shall be accurately and securely fitted up before the rivets are driven. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled. Rivets shall be heated uniformly to a light cherry-red color and shall be driven while hot. They shall not be overheated or burned.

801.8 BOLTED CONNECTIONS. Bolts shall be unfinished bolts, turned bolts, or high strength steel bolts, as shown on the plans or specified in the Project Specifications.

Unfinished or turned bolts shall have hexagonal heads and nuts and shall be of such length that they will extend entirely through the nut but not more than 1/4 inch (6 mm) beyond. Bolts in tension shall have 2 nuts. Unfinished bolts in shear shall have not more than one thread within the grip. The diameter of the unfinished bolt shall not be more than 1/32 inch (1 mm) smaller than the diameter of the hole.

The threads of turned bolts shall be entirely outside the grip. The holes for turned bolts shall be reamed and the bolts shall be finished to provide a driving fit. Approved nut locks or flat washers 1/4 inch (6 mm) thick shall be furnished, as

specified.

801.8.1 Bolted Parts: Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. Holes may be punched, subpunched and reamed, or drilled, as required by the applicable specification and shall be of a nominal diameter not more than 1/16 inch (1.58 mm) in excess of the nominal bolt diameter.

When assembled, all joint surfaces, including those adjacent to the boltheads, nuts or washers, shall be cleaned with high cycle wire brush sander or discgrinder and be free of scale, burrs, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer or other coatings, except as listed below:

801.8.1.1 Hot dip galvanized. If contact surfaces are scored by wire brushing, treatment shall be a light application of manual or power brushing that marks or scores the surface but removes relatively little of the zinc coating. The blasting treatment shall be a light "brush-off" treatment which will produce a dull gray appearance. However, neither treatment shall be severe enough to produce any break or discontinuity in the zinc surface. When ASTM A 490 bolts are specified to connect hot dip galvanized parts, the bolts shall be painted to prevent possible electrolytic action. ASTM A 490 bolts shall not be galvanized.

801.8.1.2 Inorganic zinc rich paints are defined in those sections of the Steel Structures Painting Council Systems PS 12 covering zinc rich paints with inorganic vehicles.

801.8.1.3 Metallized zinc or aluminum applied in accordance with AWS C2.2, except that subsequent sealing treatments described in Section IV therein shall not be used.

801.8.2 Installation: Bolts shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. A flat washer may be used when the abutment surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for lack of parallelism.

ASTM A 490 bolts shall have two hardened washers, and they shall not be torqued. All fasteners shall be tightened to give at least the required minimum bolt tension values shown in Table I on completion of the joint. Tightening shall be done with properly calibrated wrenches or by the "turn-of-nut" method.

801.8.3 Calibrated Wrenches: When calibrated wrenches are used to provide the minimum bolt tension specified in Table I, their setting shall be such as to induce a bolt tension slightly in excess of this value. These wrenches shall be calibrated (at least once each working day for each bolt diameter being installed) by tightening, in a device capable of indicating actual bolt tension, not less than 3 typical bolts from the lot to be installed. Power wrenches shall be adjusted to stall or cut-off at the selected tension. If manual torque wrenches are used, the torque indication corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. Nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be returned to "touch up" bolts previously tightened which may have been loosened by the tightening of subsequent bolts until all are tightened to the prescribed amount.

801.8.4 Turn-of-nut: When the turn-of-nut method is used to provide the bolt tension specified in Table I, there

shall be first enough bolts brought to a "snug tight" condition to insure that the parts of the joint are brought into full contact with each other. Snug tight is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table II with tightening progressing systematically from the most rigid part of the rigid to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE I - BOLT TENSION

ASTM A 325 BOLTS			
Bolt Size (inches)	Recommended Bolt Tension for Calibrated Wrenches (Lbs)**	Minimum Bolt Tension (Lbs)*	Approx. Torque for Minimum Bolt Tension (Ft Lbs)***
1/2	12,500	12,050	100
5/8	20,000	19,200	200
3/4	30,000	28,400	350
7/8	41,000	39,250	570
1	54,000	51,500	860
1-1/8	59,000	56,450	1,060
1-1/4	75,000	71,700	1,490
1-3/8	89,500	85,450	1,960
1-1/2	109,000	104,000	2,600

ASTM A 490 BOLTS			
Bolt size (inches)	Recommended Bolt Tension for Calibrated Wrenches (Lbs)**	Minimum Bolt Tension (Lbs)*	Approx. Torque for Minimum Bolt Tension (Ft Lbs)***
1/2	15,500	14,900	120
5/8	25,000	23,700	240
3/4	37,000	35,100	440
7/8	51,000	48,500	700
1	67,000	63,600	1,060
1-1/8	84,000	80,100	1,500
1-1/4	107,000	101,800	2,120
1-3/8	127,500	121,300	2,780
1-1/2	155,000	147,500	3,690

* Equal to 70% of specified minimum tensile strength of bolt.

** Approximately 5% in excess of the minimum bolt tension.

*** Values given are for experimental approximates for nonlubricated bolts and nuts and are based on 0.0167 ft. lb. per inch bolt diameter per lb. minimum bolt tension. The actual value shall be determined during calibration of inspection wrenches.

TABLE II
NUT ROTATION¹ FROM SNUG TIGHT CONDITION

Bolt Length (as measured from underside of head to head to extreme end of point)	Disposition of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (bevel washer not used)	Both faces sloped not more than 1:20 from normal to bolt axis (bevel washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters ²	2/3 turn	5/6 turn	1 turn

¹ Nut rotation is relative to bolt, regardless of the element (nut or bolts) being turned. For bolts installed by 1/2 turn and less, the tolerance should be plus or minus 30 deg.; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 deg.

² When bolt lengths exceed 12 diameters, the required rotation must be determined by actual tests in a suitable tension device simulating the actual conditions.

801.8.5 Inspection: When the calibrated wrench method of tightening is used, the engineer shall have full opportunity to witness the calibration tests prescribed above. The engineer shall observe the installation and tightening of bolts to determine that the selected tightening procedure is properly used and shall determine that all bolts are tightened.

Bolts shall be inspected by applying a properly calibrated manual torque wrench in the tightening direction to 10 percent of the bolts, but not less than two bolts, selected at random in each connection. If no nut or bolt head is turned by the application of the job inspecting torque, the connection shall be accepted as properly tightened. If any nut or bolt head is turned by the application of less than the specified torque, this torque shall be applied to all bolts in the connection, and all bolts whose nut or head is turned by less than the specified torque, shall be tightened and reinspected, or alternately, the fabricator or erector, at his option, may retighten all of the bolts in the connection and then resubmit the connection for inspection.

The procedures for inspecting and testing the lock-pin and collar fasteners and their installation to assure that the required preload tension is provided shall be as approved by the engineer. The contractor in the presence of the engineer shall perform the inspection as called for and provide the personnel and required manual torque wrench.

801.9 JOINTS AND CONNECTIONS.

801.9.1 Edge Planing. Sheared edges of plates more than 5/8 inch (16 mm) in thickness and carrying calculated stress shall be planed to a depth of 1/4 inch (6 mm).

801.9.2 Facing of Bearing Surfaces. Surfaces of bearing and base plates and other metal bearing surfaces that are to come in contact with each other, with ground concrete surfaces, or with asbestos sheet packing shall be finish machined flat to within 1/32 inch (1 mm) tolerance in 12 inches (305 mm) and to within 1/16 inch (1.6 mm) tolerance over-all. Surfaces of bearing and base plates and other metal bearing surfaces that are to come in contact with preformed fabric pads, elastomeric and elastic bearing pads, or portland cement grout shall be finish-machined flat to within 1/8 inch (3 mm) tolerance in 12 inches (305 mm) and to within 3/16 inch (4.8 mm) tolerance over-all.

801.9.3 Abutting Joints. When shown on the plans, abutting joints shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/4 inch (6 mm).

801.9.4 End Connection Angles. Floor beams, stringers, and girders having end connection angles shall be built to exact length back-to-back of connection angles. If end connections are faced, the finished thickness of the angle shall not be less than that shown on the detail drawings.

801.9.5 Web Plates. In girders having no cover plates and which are not to be encased in concrete, the top edge of the web plate shall not extend above the backs of the flange angles and shall not be more than 1/8 inch (3 mm) below at any point.

801.9.6 Fit of Stiffeners. End stiffeners angles of girders and stiffener angles intended as supports for concentrated loads shall be milled or ground to secure an even bearing against the flange angles. All fillers under stiffener angles shall fit sufficiently tight to exclude water after being painted.

801.9.7 Pin and Bolted Connections. Pilot and driving nuts shall be used in driving pins. Pins shall be so bolts on bolted connections shall be screwed up tight and the threads, except when high strength bolts are used, burred at the face of the nuts with a pointed tool.

801.9.8 Pins and Rollers. Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth, and free from flaws. The final surface shall be produced by a finishing cut. Pins and rollers more than 7 inches (178 mm) in diameter shall be forged and annealed. In pins larger than 9 inches (229 mm) in diameter, the forgoing shall be permitted to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling, and a hole not less than 2 inches (51 mm) in diameter shall be bored full length along the axis of the pin before being annealed. The diameter of the pin hole shall not exceed that of the pin by more than 1/50 inch (0.5 mm) for pins 5 inches (127 mm) or less in diameter, or 1/32 inch (1 mm) for larger pins.

801.9.9. Screw Threads. Screw threads shall make close fits in the nuts and shall be Unified Standard Series conforming to ANSI B1.1.-1960.

801.9.10 Bearings and Anchorage. Anchor bolts shall be either headed bolts, installed with or without pipe sleeves, or swedge bolts installed in drilled holes, as detailed on the plans. The anchor bolts shall be carefully installed to permit true positioning of the bearing assemblies. When anchor bolts are installed in pipe sleeves, the pipes shall be completely filled with grout at the time the grout pads are constructed or at the time the bearing assemblies or masonry plates are placed. Swedge bolts installed in holes shall be either sulphured-in or grouted-in as shown on the plans. All bearing assemblies shall be set level and to the elevations shown on the plans. Adjustments in the horizontal positions of bearing assemblies shall be made for temperature as directed by the Engineer.

In conformance with the details shown on the plans, masonry plates and the bearing plates of bearing assemblies shall

be set on ground concrete surfaces, on preformed fabric pads, or on grout pads. Grout to be placed below masonry plates or bearing plates of the bearing assemblies and in anchor bolt sleeves shall consist of Class "E" mortar. Concrete areas to be in contact with the grout shall be cleaned of all loose or foreign matter that would in any way prevent bond between the mortar and the concrete surfaces and shall be kept thoroughly saturated with water for a period of not less than 24 hours immediately prior to placing the grout. The grout shall contain only sufficient moisture to permit packing and shaping. The grout shall completely fill the anchor bolt sleeves and shall be tightly packed under the masonry or bearing plates to provide full bearing. After placing, all exposed surfaces of the grout pads shall be kept covered with a heavy thickness of burlap saturated with water for a period of 3 days. All improperly cured or otherwise defective grout shall be removed and replaced at the Contractor's expense.

801.10 WELDING. All welding shall conform to the requirements of the "Specifications for Welded Highway and Railway Bridges" of the American Welding Society, the requirements of these specifications, and the Special Provisions.

Inspection of welding made to control the quality of welds and workmanship will be performed in accordance with the requirements of the AWS. All welding may be subject to radiographic or other nondestructive testing. Such nondestructive testing will be performed without charge to all costs involved in re-inspection shall be borne by the contractor.

Weld metal shall be sound throughout except that very small gas pockets and small inclusions of oxide or slag may be permitted if well dispersed, and if none exceeds 1/16 inch (1.5 mm) in greatest dimension of all such defects in any square inch (645 mm²) weld area does not exceed 3/8 inch (9 mm).

All welding of structural steel (ASTM A-36, A-242, and A-441) shall be performed by either the submerged or gas shielded arc process, or with low hydrogen electrodes. All welding of low alloy structural steel shall be qualified by procedure tests before fabrication is commenced. Portions of members in bearing assemblies or indirect bearing shall be straightened, planed, or otherwise corrected after fabrication as necessary to provide full bearing on bearing assemblies or bearing areas on level bearing plates.

Where the end of a stiffener plate is shown "tight-fit" on the plans, the end of the plate shall be so fitted that it bears on the beam flange with at least point bearing. Local clearances between the end of the plate and the flange shall not exceed 1/16 inch (1.6 mm).

Unless otherwise shown on the plans or specified, erection bolts required for welded splices or welded connections may be left in place and the ends of all such erection bolts which project beyond the nut shall be burned off flush with the face of the nut. Where the bolt does not project, the end of the bolt and nut shall be tack welded to prevent loosening of the nut. Burning off projecting bolt ends and tack welding shall be performed prior to painting.

801.11 TORCH CUTTING. The use of a cutting torch is permissible if the metal being cut is not carrying stress during the operation. The radius of re-entrant flame cut fillets shall be as large as possible but never less than 3/4 inch (19 mm). To determine the net area of members so cut, 1/8 inch (3 mm) shall be transmitted through a flame-cut surface. Where cutting with a torch, cuts shall be true to line with a maximum deviation of 1/16 inch (1.6 mm). All burned edges shall be finished by grinding.

801.12 BENT PLATES. Cold-bent load-carrying rolled steel plates shall conform to the following:

- (1) They shall be so taken from the stock plates that the direction of bending will be at right angles to the direction of rolling.
- (2) The radius of bend, measured to the concave face of the metal, shall not be less and preferably shall be greater than shown in the following table, in which a "T" is the thickness of the plate:

Angle Through Which Plate is Bent	Minimum Radius
61 deg. to 90 deg	1.0 T
91 deg. to 120 deg	1.5 T
121 deg. to 150 deg	2.0 T

- (3) Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch (1.6 mm) throughout that portion of the plate at which the bending is to occur.

801.13 METHOD OF MEASUREMENT.

801.13.1 Weight Basis: All structural steel will be measured by the weight of metal in pound remaining in the completed and accepted structures. The weight will be computed on the basis of theoretical net weight from the approved shop drawings. No allowance will be made for rivets, bolts, nuts, washers, or welds and no deductions will be made for rivet holes, bolt holes, beam copings, cut flanges or edge preparation for welding. Deduction will be made for pin holes. All plates shall be estimated from the sizes and billed and deductions made for cut corners.

No measurement of structural steel of any class will be allowed for temporary work of any kind or for additional weight in members provided for erection purposes.

No allowance will be made in the pay quantity for any items not remaining in the finished structure except as hereinafter provided.

No allowance will be made for shop or field paints, galvanizing or other coatings.

No allowances will be made for over-run on plates or rolled sections.

When full-sized test of built-up structural members and eyebars are required by the contract, any full-size members tested to destruction will be measured if the test proves satisfactory. However, if the test proves the member to be unsatisfactory, the members represented by it will be rejected and no measurement or allowance will be made for such members.

Steel (A-36): This steel shall include all metal classified as such on the plans and unless otherwise noted on the plans, such minor items as anchor materials including pins, rollers, metal railings, steel plates and shapes for expansion joints, ladders, wrought iron sheets, checkered floor plates, bronze castings and plates, steel castings, and iron castings (except cast iron drains in floors) and all other metal items necessary to complete this portion of the structure. Shear connectors will not be measured for payment, but will be considered as incidental to the work. Structural steel shall be

computed on the basis of weighing 490.0 lbs./cu. ft. unless specified otherwise in Project Specification or required by the Engineer.

801.13.2 Lump Sum Basis: When payment is specified to be made by the lump sum, no weight measurement of metal will be made. The estimate of the weight of structural metalwork shown on the plans is approximate and no guarantee is made that it is the correct weight to be furnished. It will be the bidder's responsibility to determine the correct weight of each grade of metal to be furnished under the lump sum item. No adjustments in contract price will be made due to errors in the estimated weight shown on the plans. Shop bills will not be required.

801.14 BASIS OF PAYMENT

801.14.1 Weight Basis: The accepted quantities of structural steel will be paid for at the contract unit price per pound.

801.14.2 Lump Sum Basis: The completed and accepted items will be paid for at the contract lump sum price, which includes furnishing, fabricating, erecting, painting, galvanizing or other coating (if required) of all necessary materials; furnishing all required labor, plants, equipment, tools, staging, false work, forms, power welding, bolts and other hardware; and the performance of all work necessary to complete the item.

If changes in the work are ordered by the Engineer, which vary the weight of steel to be furnished, the lump sum payment will be adjusted as follows:

The value per pound of the increase or decrease in the weight of structural steel involved in the change will be determined by dividing the contract lump sum amount by the estimated weight shown on the plans. The adjusted contract lump sum payment will be the contract lump sum amount plus or minus the value of the steel involved in the change, and no additional compensation will be made on account of said change.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
801 (1)	Structural Steel	Per Pound
801 (2)	Structural Metalwork	Lump Sum

SECTION 802

METAL RAILINGS

802.1 METAL HAND RAILINGS.

802.1.1 General. The materials for metal hand railings shall conform to the requirements of Subsection 207.7.1. Except where a standard drawing is referred to on the plans, the contractor shall, in accordance with Part I, submit shop drawings showing the details and dimensions of all metal railings. All material and installation shall conform to the latest ADA standards.

802.1.2 Fabrication. Welding shall conform to the requirements of the AWS Structural Welding Code D1.1, for steel, and to the requirements of the "Specifications for Aluminum Structures" of the Aluminum Association, for aluminum alloys. All exposed welds shall be ground flush with adjacent surfaces.

Railing panels shall be straight and true to dimensions. Adjacent railing panels shall align with each other with a variation not to exceed 1/16 inch (1.6 mm). Joints shall be match-marked.

For structures on curves, either horizontal or vertical, the railing shall conform closely to the curvature of the structure by means of series of short chords. The lengths of the chords shall be the distance center-to-center of rail posts.

Steel railing units shall be galvanized after fabrication in accordance with the requirements of Subsection 210.8.

Completed aluminum railing units shall be anodized after fabrication, conforming to the requirements of the Aluminum Association Standard for Anodized Architectural Aluminum, Class I Anodic Coating, AA-C22-A41.

802.1.3 Installation. The railing shall be erected in accordance with the plans on anchor bolts, or in holes formed by inserts provided in the concrete railing base to receive the railing posts. Sheet metal inserts shall be removed before the erection of the railing.

No railing shall be erected on the structure until the sidewalk to which it is to be attached is completed and all false work supporting the system is released.

The railing shall be carefully erected, true to line and grade. Posts and balusters shall be vertical with the deviation from the vertical for the full height of the panel not exceeding 1/8 inch (3.2 mm).

802.2 HIGHWAY GUARD RAIL.

802.2.1 General. This work shall consist of the construction of metal beam guard railing, at the locations and in accordance with the plans, and as specified in the Project Specifications. Materials for metal beam guardrail shall conform in all respects to Subsection 207.7.2 thru 207.7.5.

802.2.2 Installation. The posts shall be firmly placed in the ground. The space around posts shall be backfilled with selected earth, free of rock, placed in layers approximately 4 inches (102 mm) thick and each layer shall be moistened and thoroughly compacted.

Posts shall be placed at equal intervals as shown on the plans, except that the end posts may be spaced closer to adjacent posts if directed by the Engineer.

The metal work shall be fabricated in the shop, and no punching, cutting or welding will be permitted in the field. Rail elements shall be lapped so that the exposed ends will not face approaching traffic. Terminal sections shall be installed in accordance with the manufacturer's recommendations. Surplus excavated material remaining after the guard railing has been constructed shall be removed from the work site.

802.3 MEASUREMENT AND PAYMENT.

802.3.1 Railing. The various types of railing will be measured by the linear foot from end to end along the face of the railing, including terminal sections.

The price paid per linear foot for railing in place shall include full compensation for furnishing all labor, materials, tools, and equipment and performing all work involved in construction of the guardrail as shown on the plans.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
802(1)	Steel Hand Rail	Linear Foot
802(2)	Aluminum Hand Rail	Linear Foot
802(3)	Guard Rail	Linear Foot
802(4)	Guard Rail (Double Faced)	Linear Foot
802(5)	Guard Rail (Anchor Section)	Linear Foot

SECTION 803

CHAIN LINK FENCE

803.1 GENERAL. Materials for chain link fence shall conform to the requirements of Subsection 207.8.

803.2 FENCE CONSTRUCTION. Posts shall be spaced at not more than 10 foot (3.05 m) intervals, measured from center-to-center of posts, and shall be placed in a vertical position.

Changes in line or grade where the angle of deflection is 30 degrees or more, shall be considered as corner and slope points, respectively, and corner or slope posts shall be installed at these points.

Footings for fence posts shall be concrete of the Class R. Footings shall be crowned at the top to shed water.

Unless otherwise specified, all fence shall be installed with a top rail and a bottom tension wire. When top rail is omitted, a top and bottom tension wire shall be used.

The fabric shall be placed on the outward facing side of the posts and shall be installed so that the top edge projects over the top rail of the fence. The fabric shall be stretched taut and securely fastened to the posts, the top rail, and the bottom tension wire. The tension wire shall be installed parallel to the line of the fabric. The bottom of the fabric shall extend to within 2 inches (51 mm) of the natural ground or paved surface. High points of ground shall be excavated to clear the bottom of the fabric, and depressions shall be filled and compacted to within 1 inch (25.4 mm) of the bottom fabric.

The fabric shall be fastened to end, corner, slope, and gate posts with 3/16 inch x 3/4 inch (5 mm x 19 mm) high carbon steel tension bars and not less than 12 gage x 1 inch (25.4 mm) steel tension bar bands spaced at 16 inch (406 mm) intervals; and to line posts, top rail, and tension wire with tie wires or metal bands. Tie wire or metal bands shall be placed on line posts at intervals of approximately 16 inches (406 mm), and on top rail and tension wire at intervals of approximately 24 inches (610 mm).

803.3 INSTALLATION OF GATES. Gates with fabric 7 feet (2.13 m) or more in height shall have a horizontal stiffener. Vertical stiffeners shall be installed at a maximum of 8 foot (2.44 m) centers. A 3/8 inch (9.5 mm) adjustable tension rod shall be installed on all gates over 4 feet (1.22 m) in width.

The corners of gate frames shall be fastened together and reinforced with a fitting designed for the purpose or by welding. All welds shall be ground smooth.

Chain link fence fabric shall be attached to the gate frame by the use of tension bars and tie wires as specified for fence construction, and suitable tension connectors spaced at approximately 16 inch (406 mm) intervals.

The swing gates shall be hung by at least 2 steel or malleable iron catch and locking attachment of approved design. Stops to hold gates open and a center rest with catch shall be provided where required.

803.4 METHOD OF MEASUREMENT.

803.4.1 New Fence and Gates: New fence will be measured by the linear foot between the outside of end posts for each continuous run of fence, exclusive of gates. Gates for new fence will be measured per each gate for single swinging gates, and per double gate for double swinging gates.

803.4.2 Rebuilt Fence: Rebuilt fence will be measured by the linear foot between the outside of end posts for each continuous run of completed and accepted fence inclusive of gates.

803.5 BASIS OF PAYMENT. The accepted quantities of fence and gates will be paid for at the contract unit prices.

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
803(1)	Chain Link Fence (____-Foot____Height)	Linear Foot
803(2)	____-Foot Single Gate for Chain Link Fence (____-Foot Height)	Each
803(3)	____-Foot Double Gate for Chain Link Fence (____-Foot Height)	Each
803(4)	Rebuilt Fence	Linear Foot

PART 9

PILE DRIVING AND TIMBER CONSTRUCTION

SECTION 901

PILE DRIVING

901.1 MATERIALS. Pile types shall be as indicated on the Drawings and in accordance with the following subsections for the various types.

Treatment with Preservatives	205.2
Timber Piles	206.1
Steel Piles	206.2
Concrete Piles	206.3

901.2 GENERAL. Piles shall be accurately located and driven either vertically or to the prescribed batter as indicated on the plans. No greater variation from the vertical or specified batter line than 1/4 inch per foot (20 mm per meter) of length will be permitted. Piles driven with greater variation and those seriously damaged in driving shall be removed or cut off, and replaced with new piles. Should any pile be heaved by the subsequent driving of adjacent piles, it shall be re-driven.

The pile tip elevations shown on the plans are approximate, and are to be used as a basis for establishing quantities for piling, including test piles, for bidding purpose only. When required in the Project Specifications, one pile of the type selected or designated for the work shall be driven in each pier and abutment area as a test pile. The location of these piles shall be determined by the Engineer.

Test piles shall be driven to determine the length and penetration that will be required for the balance of the piles. No piles other than test piles shall be driven at each pier or abutment until such determination has been made by the Engineer and has been reported to the contractor.

The conditions under which the test piles are to be driven shall be as ordered by the Engineer. These test piles shall be furnished and driven by the contractor, and under normal circumstances shall be left in place and utilized as one of the specified piles. Test piles shall be driven with the same size and type hammer operation with the same effective energy and efficiency as that to be used in driving the remainder of the piles. The Engineer shall specify the tip elevation to which the piling shall be driven for each pier or abutment. All piles shall be driven for each pier or abutment. All piles shall be driven to the tip elevation established by the Engineer, or deeper if necessary to develop the bearing value as determined by the formula prescribed in Subsection 901.6.

Excavations required in the areas through which the piles are to be driven shall be made before any pile is driven. No excavation may be made below the bottom of the pile footing elevation, unless approved by the Engineer. When piles are to be driven through the bridge approach embankment and the depth of the embankment at the pile location is in

excess of 5 feet (1.52 m), the pile shall be driven in a hole drilled through the embankment. The hole shall have a diameter of not less than the butt diameter of the pile plus 6 inches (152 mm). After driving the pile, the annular space around the pile shall be filled to ground surface with dry sand or pea gravel.

No piles shall be driven within 25 feet (7.62 m) of any concrete that has not attained a minimum compressive strength of 2000 psi (13.79 Mpa).

To eliminate hazard to life and to preclude dirt or debris from falling or being thrown into them, the tops of driven pile shells or drilled holes shall be securely covered immediately upon withdrawal of the mandrel or drilling equipment.

901.3 DRIVING EQUIPMENT. Pile hammers shall be approved types that develop energy per blow at each full stroke of the piston of not less than 1-foot-pound for each pound (2.99 J Per kg) of weight driven. Diesel and vibratory pile hammers may be used only when approved by the Engineer. Drop hammers may be used on timber piles only. Drop hammers shall weigh not less than 3,000 pounds (1361 kg) and shall be equipped with proper leads and hoisting equipment to handle the work efficiently. The fall of the hammer shall not exceed 10 feet (3.05 m).

Steam or air hammers shall be furnished with boiler or air capacity at least equal to that specified by the manufacturers of the hammers being used. The boiler or compressor shall be equipped at all times with an accurate pressure gage. The valve mechanism and other parts of steam or air hammers shall be maintained in first class condition so that the length of stroke and number of blows per minute for which the hammer is designed can be obtained at all times. Steam or air hammers not meeting the specifications shall be removed from the work.

When necessary to obtain the specified penetration and with the approval of the Engineer, the contractor may be required to supply and operate one or more water jets and pumps; or to furnish the necessary drilling apparatus and drill holes and drive the piles therein as specified in Subsection 901.4.

The use of jets at locations, where the stability of embankments or other improvements would be endangered, will not be permitted. Jetting will not normally be permitted in cohesive soils. All jetting must be suspended and the pile driven for the last 3 feet (.91 m) to specified bearing. The cost of any jetting or drilling that may be required shall be included in the price bid for driving piles, or for other applicable items or work. The use of followers, underwater hammers, or hammers not in leads will be permitted only upon written authorization of the Engineer. When a follower or underwater hammer is authorized, the first pile in each bent shall be furnished sufficiently long for it to be driven without a follower or underwater hammer, and the bearing value and penetration shall be determined from this pile.

901.4 DRILLED HOLES

901.4.1 Driven Pile. When approved by the Engineer, piles may be driven in predrilled holes. The holes shall have a diameter not greater than the diameter of the pile at ground surface. The depth of the predrilled hole shall be adjusted by the contractor (as directed by the Engineer) as the work proceeds in order to maintain adequate bearing. Piles shall be driven sufficiently to secure full bearing. Minimum penetration of the pile below the bottom of the predrilled hole shall be 5 feet (1.52 m) unless otherwise authorized by the Engineer.

901.4.2 Drilled Holes - Cast-in-Place-Piles. Holes for cast-in-place concrete piles shall be drilled dry to the tip elevations shown on the plans or determined by the Engineer. All holes shall be inspected for straightness prior to placing concrete therein. When viewed from the top, more than one-half of the entire bottom area must be visible.

901.4.3 Drilling Material. All loose material existing at the bottom of the hole after drilling operations have been completed shall be removed before placing concrete in the hole.

901.4.4 Water. The use of water for drilling operations, or for any other purpose where it may enter the hole, will not be permitted. Surface water shall not be permitted to enter the hole and all water which may have infiltrated into the hole shall be removed before placing concrete therein.

901.4.5 Casings. Suitable casings shall be furnished and placed when required to prevent caving of the hole before concrete is placed therein. Casing used in drilling operations shall be removed from the hole as concrete is placed therein. The bottom of the casing shall be maintained not more than 5 feet (1.52 m) nor less than 1 foot (.30 m) below the top of the concrete during withdrawal and placing operations, unless otherwise permitted by the Engineer. Separation of the concrete during withdrawal operations shall be avoided by hammering or otherwise vibrating the casing.

901.4.6 Reinforcing Cage. The reinforcing cage shall be placed and secured symmetrically about the axis of the pile and shall be securely blocked to clear the sides of the hole.

901.4.7 Concrete. Care shall be exercised to insure that the concrete in the hole is dense and homogenous. Vibration of the concrete during placing will not be required. After the hole has been filled with concrete, the top 10 feet (3.05 m) of the concrete, or the length of the reinforcing, whichever is the greater, shall be vibrated.

901.5 DRIVING. During driving operations the pile heads shall be protected and held in position by the use of a steel driving block or anvil. Timber piles shall be shaped to closely fit the driving head. The heads of the piles may be protected by means of heavy steel or wrought iron rings. The heads of concrete piles or casings shall be protected from direct impact of the hammer by a cushion block which shall be maintained in good condition during the entire driving operation. This cushion block shall be so arranged that any reinforcing bars projecting above the piles will not be displaced or damaged in driving. For driving steel H-beams piles and shells without a mandrel for cast-in-place concrete piles, steel combinations driving heads and pilots shall be used. The driving heads shall closely fit the top of the steel pile or shell and shall extend down the sides of the pile at least 4 inches (102 mm). Pile materially out of line, as determined by the Engineer, shall be pulled and replaced.

901.6 BEARING VALUE. Piles shall be driven to the penetration shown on the plans as a minimum. Timber piles shall not be driven to a bearing value exceeding 20 tons (177.9 KN). The bearing value shall be determined from the applicable formula in the following schedule:

For piles driven with a drop hammer:

$$P = \frac{2WL}{s + 1}$$

For piles driven with a single acting steam or air hammer:

$$P = \frac{2WL}{s + 0.1} \quad \text{or} \quad P = \frac{2E}{s + 0.1}$$

P = Safe bearing load developed by the pile in pounds.

W = Weight of the hammer in pounds.

L = Length of stroke or height of fall of the hammer in feet.

S = Penetration of the pile into the ground per blow in inches, taken as the average over the last 10 blows. Penetration shall be measured at a time when there is no appreciable rebound of the hammer and the preceding blow was struck upon a sound pile head or driving block.

E = Manufacturer's rating of energy developed by the hammer in foot pounds.

901.7 CUTOFF AND EXTENSION. Timber piles which are to be capped shall be accurately cut off so that true bearing is obtained on every pile without the use of shims. Other timber piles shall be cut off on the square at the elevation designated. Piles inaccurately cut off shall be replaced. Splicing of timber piles will not be permitted.

Except for piles that are to be capped with concrete, the tops of treated piles, after cutoff, shall be treated as specified in Subsection 205.2.

Concrete piles shall be cut off at such elevations that they will extend into the cap or footing as indicated on the plans. Concrete piles may be cast the full length of the reinforcing bars, provided that the concrete is cut off to expose the steel as shown on the plans after the piles have been driven. When concrete piles are driven or cut off below the elevation of the bottom of the cap, the pile section shall be extended to the elevation of the bottom of the cap by means of a reinforced concrete extension constructed in accordance with the details shown on the plans. Concrete shall be removed from the end of the pile to expose sufficient reinforcing steel to permit a lap of at least 35 diameters.

Steel shells or concrete casings for cast-in-place concrete piles shall be cut off at the designed elevations. The work of cutting off precast concrete piles or concrete casings shall be performed in such a manner as to avoid spalling or damaging the pile below cut-off. In case of such damage, the pile shall be replaced or repaired as required by the Engineer. All cut off lengths of piling shall become the property of the contractor and shall be disposed of outside the project area.

901.8 LOAD TESTING. If load tests are required, they shall be performed on the test piles. The loading shall not be applied until 48 hours after the pile is driven or, in case of cast-in-place piles, the concrete has attained a minimum compressive strength of 2,000 pounds per square inch (13.788 Mpa). A loading test shall consist of the continuous application of a load of twice the design load to the pile being tested. The pile shall be considered to have a bearing value equal to the design load if the permanent settlement produced by such test loading is not greater than 1/4 inch (6.4 mm). Unless otherwise permitted by the Engineer, the loading tests shall be completed before the remaining piles are cast or driven.

When a loading test is required, the contractor shall provide suitable facilities and equipment by means of which a prescribed test load can be transmitted vertically to each pile to be tested. Provisions for varying the applied load shall also be made, and the loads must be in known and measurable increments, applied axially to the pile. The marks, gages, dials, or other instruments of any loading equipment required to determine settlement of the pile, shall be arranged so as to provide convenient observation thereof without danger to the observer or the equipment. All test equipment shall be accurately calibrated and shall be approved by the Engineer.

The test loads shall be applied under the direction of the Engineer, and at such rate or in such increments as he may specify. When a load test of a pile is commenced, the test shall be continuous, and the contractor shall furnish all facilities on a 24-hour, 7-day week basis until the test is completed. Forty-eight hours after all deflection and settlement has ceased, or sooner if directed by the Engineer, the test load shall be removed at such rate or in such increments as

the Engineer may direct. If the results of the above described operations indicate that excessive permanent settlement of the test pile has occurred, the pile shall be driven to such additional depths as the Engineer may specify, and the above described test loading operations repeated. Each complete operation, which shall include loading and unloading as above prescribed, shall be considered as an individual test.

901.9 METHOD OF MEASUREMENT.

901.9.1 Pilings: Pilings driven in the locations designated on the plans will be measured by the linear foot of pile, complete in place, below cut-off elevation.

901.9.2 Cut-Offs: Cut-offs made as directed will be measured by the linear foot. Payment will not be made for the cut-off of any pile unless the length of such cut-off is in excess of one linear foot, nor will payment for cut-offs be made where they have been necessitated by crushing, brooming, splitting or other injuries resulting from careless driving. No payment will be made for required cut-offs of steel bearing piling and cast-in-place concrete pile shells; such cut-offs will remain the property of the contractor.

901.9.3 Re-driving Test Piles: Re-driving of test piles will be measured for each test pile for which re-driving is required.

901.9.4 Splices:

901.9.4.1 Steel Bearing Piles: Measurement of splices on steel bearing piles will be made by the linear foot. The total number of linear feet of piling driven will be determined by adding 2 feet to the net length of piling for each splice in place in the finished structure. No measurement will be made for splices except those made as directed.

901.9.4.2 Cast-in-Place Concrete Piles: Splices for cast-in-place concrete piles will not be measured as a splice.

901.9.5 Test Piles: The number of test piles to be paid for will be the number of individual piles of each type furnished and driven as directed. Cut-offs of test piles will not be included in any pay footage. Test piles pulled and re-used as permanent piles will be measured as provided under paragraph 901.9.1.

901.9.6 Loading Test Piles: The number of load tests to be paid for will be the number of load tests ordered and completed.

901.9.7 Piling: The accepted quantities of piling will be paid for at the contract unit price per linear foot which includes all materials, labor and incidentals required for bolting, wrapping or fastening timber fender piles and shall include the concrete and reinforcing steel in cast-in-place concrete piles and will include any jetting or pilot holes required. This price shall also include the re-driving or permanent piles that are used for anchor piles.

901.9.8 Cut-Offs: payment for cut-offs will be made at the rate of 2/3 the contract unit price per linear foot for the particular type of pile which has been cut off.

901.9.9 Extensions: Payment for cast-in-place extensions will be made at the contract unit price per linear foot for the type and size of pile being extended.

901.9.10 Splices: Payment for splices will be made at the contract unit price per linear foot for the particular type

of pile spliced.

901.9.11 Test Piles: Test piles will be paid for at the contract unit price per each.

901.9.12 Loading Test Piles: Loading test piles will be paid for at the contract unit price per each.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
901 (1)	Precast concrete Piles (Size)	Linear Foot
901 (2)	Untreated Timber Piles	Linear Foot
901 (3)	Treated Timber Piles	Linear Foot
901 (4)	Steel Bearing Piles (Size)	Linear Foot
901 (5)	Cast-in-Place Concrete Piles (Size)	Linear Foot
901 (6)	Precast Concrete Test Piles	Each
901 (7)	Timber Test Piles	Each
901 (8)	Steel Bearing Test Piles	Each
901 (9)	Cast-in-Place Concrete Test Piles	Each
901 (10)	Loading Test Piles	Each

SECTION 902

TIMBER CONSTRUCTION

902.1 GENERAL. Timber structures erected under these specifications shall conform to the dimensions and details of design shown on the drawings.

902.2 MATERIALS. Unless indicated otherwise on the Drawings or the Project Specifications, materials for timber construction shall conform to the following Subsections: Lumber - 205.1, Preservative Treatment - 205.2, Painting - 1101.

902.2.1 Handling and Storage. Timber and lumber that is stored prior to its use shall be neatly piled on skids to raise it from the ground, and shall be protected from the sun when so required, the materials being stored or piled in such a manner as to permit ready access for the purpose of inspection. The use of cant hooks, or other pointed tools and hooks, will not be permitted in the handling of structural timber, lumber, or piles. Precautions shall be exercised in handling treated material to prevent damage to the surface thereof to the extent that untreated wood is exposed. Any piece so damaged will be rejected.

If treated timber or piling is cut after treatment, such cuts shall be treated in accordance with Subsection 205.2. This requirement shall also apply to any surface that has become abraded to the extent of exposing untreated wood. All borings and holes in such material shall be similarly treated, and holes which are not to be used for rods, bolts, pins, screws, spikes and the like, or which will not subsequently be otherwise closed, shall be tightly filled with treated plugs. Timber for floors and decks, and that which is to be used in the construction of split ring or shear plate connected trusses, shall be well seasoned and thoroughly air dried before being placed or incorporated in the work. This requirement shall apply to treated material as well as to that which is untreated.

902.3 WORKMANSHIP. Workmanship shall be first class throughout. Framing shall be true and exact and none but thoroughly competent workers shall be employed or engaged in connection with the erection of any structure under these specifications. All lumber and timber shall be cut and framed to a close fit and shall have even bearing over the entire contact surfaces. No shimming will be permitted in making joints. All members shall be true to size for the full depth thereof.

Holes for drift pins in untreated lumber shall be bored with a bit 1/16 inch (1.6 mm) less in diameter than the pin or dowel. Holes for drift pins and dowels in treated lumber shall be bored with a bit of the same diameter as the pin or dowel. Holes for truss rods or bolts shall be bored with a bit 1/16 inch (1.66 mm) larger than the rod or bolt. Holes for lag screws shall be bored with a bit not larger than the base of the thread. In small timbers where the prevention of splitting is necessary, holes shall be bored for spikes with a bit having a diameter not larger than that of the spike.

In the installation of metal timber connectors, care shall be exercised to insure that the connector is installed concentric with its corresponding bolt; and if more than one connector bolt is installed in any individual joint, all bolts in such joint shall be drawn up to an even and uniform tension. The grooves for split-ring and shear plate connectors shall be carefully cut to a uniform width and depth for the full perimeter therefore. The dimensions of these grooves, and the manner and means of cutting, shall be recommended by the manufacturer of the particular connector to be installed, and any special tool or equipment used in cutting the grooves shall be operated in the manner and at the speed similarly recommended.

Toothed-ring and spiked-grid connectors shall be installed by means of pressure equipment of a type intended for the purpose. However, split-ring connectors shall not be forced on, but shall be expanded to such an extent as to readily slip over the core formed by the groove without damaging the wood.

All bolts, unless otherwise indicated on the plans, shall be 3/4 inch (19 mm) in diameter or larger and shall be of sufficient length to project beyond the nut when the nut is drawn tight. Bolts shall be fitted at each end with either a malleable iron (ogee) washer or a steel plate at least 3 inches (76 mm) square and not less than 3/8 inch (9.5 mm) thick, or as otherwise shown on the plans.

902.4 FRAMING. Mudsills shall be firmly and evenly bedded on solid material. Sills and caps shall have a full, even bearing on the pedestals, posts or piles and shall be secured in place as indicated on the plans.

Bents shall be accurately aligned before the bracing is placed. Bracing shall be fastened at the ends and at each intersection by bolts. Bracing shall be of such lengths as will provide a minimum distance of 8 inches (203 mm) between the outside bolt and the end of the brace. Treated posts or piles shall not be cut to accommodate the bracing. Treated filler blocks shall be used if necessary to fill any space that may occur between the bracing and the member of the bent.

In placing joists, the best edge shall be placed down. The elevation of the tops of adjacent joists shall not vary more than 1/8 inch (3 mm). Outside joists shall have butt joints. Interior joists shall be lapped and shall extend the full width of the cap to obtain full bearing. Bridging between joists shall be solid and fastened to the joists near the top of the block and on each side of the bottom of the block. Bridging shall be accurately cut to fit closely between the joists. Trusses, when completed, shall show no irregularity of line. Chords shall be straight and true from end to end in horizontal projection, and in vertical projection shall show a smooth curve through panel points conforming to the correct camber. Uneven and rough cuts at the points of bearing shall be cause for rejection of the piece containing the defect.

Laminated bridge floors shall be constructed as shown on the plans. The planks shall be laid with the best edge down. Spiking of deck planking in roadway areas of bridges and similar structures shall be accomplished by the means of an air hammer equipped with a suitable driving head so designed and constructed as to insure that the spikes are driven to sufficient depth to draw the planking tightly to the joins without damaging or abrading the surface of the plank.

902.5 PAINTING. Parts of the structure to be painted shall be those surfaces indicated on the plans to be painted, and painting shall be as prescribed in Section 1101. Metal parts and hardware not galvanized shall be painted in accordance with Section 1101. The lumber to be painted shall be cut to fit, and the entire surface shall be given the specified prime coat. The remaining coats shall be applied after the structure has been erected.

902.6 MEASUREMENT AND PAYMENT. Timber structures will be paid for as provided in the proposal. Where board measure is used as the basis of payment, the quantity to be paid for will be determined from nominal widths and thicknesses and the actual lengths of the pieces in the finished structure, except that in the case of laminated timber flooring, the number of laminations to be paid for shall be the required number of the size specified after dressing, and the length of each lamination shall be considered as the full width or length of the floor. Hardware will not be measured for payment but will be considered incidental to the work. Where lump sum payment is provided for in the proposal, it shall include the timber structure complete in place, except for piling if required. Piling will be paid

for in accordance with Section 901.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
902(1)	Untreated Timber	MFBM
902(2)	Treated Timber	MFBM
902(3)	Timber Structure Complete in Place	Lump Sum

SECTION 1001

STORM DRAIN PIPE INSTALLATION

1001.1 LAYOUT OF WORK. The contractor will establish the location of all pipe lines to be constructed and will set bench marks at prominent points adjacent to the work. Control shall be the responsibility of the contractor and shall be as approved by the Engineer.

1001.2 TRENCHING AND FORMING PIPE BED.

1001.2.1 Excavation. Excavation shall include the removal, handling, re-handling, refill or backfilling, and disposal of any and all surplus or unsuitable materials encountered in the work, and shall include all pumping, bailing, drainage, sheeting and bracing. The work of excavation shall also include the responsibility of added expenses or other liability that may arise from quicksand, obstacles or conditions, foreseen or unforeseen which may be encountered in the work. It includes clearing, removal, and required replacement of pavements, curbs, sidewalks, shrubbery, and other obstructions not otherwise provided for. Excavation shall be in accordance with the City's Standard Specification 1002, and applicable Standard Plans.

1001.2.2 Lines of Excavation. All excavation necessary for laying pipe, construction manholes, etc., shall be made to line and grade as indicated on the plans and as specified herein. Trenches shall be dug to the alignment and depth required and only so far ahead of pipe lying as the Engineer will permit. The trench shall be braced and drained as may be required so that workmen may work therein safely and efficiently per the requirements of City's Standard Specifications 1004 and 1005.

Bottoms of trenches shall be excavated and formed to provide for pipe bedding or pipe foundations as hereinafter specified or as required by the project Plans or Specifications.

Bell holes where necessary to make up the joints shall be dug of sufficient size that the whole length of the pipe barrel be bedded as required, and to allow all of the joints to be properly made.

All excavation shall be open cuts with vertical sides except in special cases where the Engineer may permit sloping sides above a point 2 feet above the top of the pipe and as approved by the Engineer or as detailed on the plans.

If tunnels are authorized or required, they shall be only as large as necessary for the installation of the pipe and as approved by the Engineer or as detailed on the plans.

1001.2.3 Methods of Excavation. The Engineer shall have the authority at any time to require the contractor to discontinue the use of any excavating machine or other appliance which, in his judgment, is not adapted to the purpose for which it is used.

1001.2.4 Exclusion or Removal of Water. The contractor shall at all times during construction provide proper and satisfactory means and devices for the exclusion of water or removal of all water entering the excavation and shall remove all such water as fast as it may collect in such a manner as shall not interfere with the prosecution of the work. No water shall be diverted into any operating sanitary sewer line. See City's Standard Specification section 1005 for trench dewatering requirements.

The contractor shall keep the completed lines free of water at all times until final completion.

1001.2.5 Maintenance of Excavation. The contractor shall maintain all excavation in good order during the construction, so as not to hinder or injure the pipe laying, masonry or other work. He shall take all reasonable precautions to prevent movement of the sides of such excavation, and shall remove at his own expense any material sliding into the excavation.

1001.3 BEDDING. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. The pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of pipe or arch. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type joint. Bedding shall be in accordance with City's Standard Specification section 1002, and applicable Standard Plans.

Where the bottom of the excavation is not, in the opinion of the Engineer, of suitable material for the construction of the required pipe foundation, the excavation shall be deepened and a concrete cradle or granular foundation shall be placed under the pipe as directed by the Engineer. The concrete mix for this cradle shall be Class R concrete and shall be mixed in the correct proportions but placed dry without adding the required water. This granular foundation or concrete cradle is not to be included in the price bid for laying pipe and will be paid for as a separate item. Granular foundation shall conform to the applicable provisions of Subsection 200.1.

1001.4 PLACING PIPE. Each pipe shall be carefully examined before being laid. A defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering section of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical lane as the major axis of the pipe. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather is unsuitable for such work.

Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipes in place shall be inspected before backfilling, and those damaged during the placement shall be removed and replaced at no additional cost to the City.

An approved mechanical pipe puller shall be used in joining all R.C. pipe over 36 inches in diameter. For pipes less than 36 inches in diameter, any approved method for joining pipes may be used which does not damage pipe.

1001.4.1 Concrete and clay pipe: Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

1001.4.2 Corrugated steel pipe and pipe arch: Laying shall be with the separate sections joined firmly together, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Part-paved pipe shall be installed so that the center line of bituminous pavement in the pipe, indicated by suitable markings on top at each end of the pipe sections, coincides with the specified alignment of pipe. Fully paved steel pipe and asbestos-bonded steel pipe or pipe arch shall have a painted or otherwise applied label inside the pipe or pipe arch indicating sheet thickness of pipe or pipe arch. Any unprotected metal in the joints shall be coated with bituminous material specified in Federal Specifications WW-P-405. Interior coating shall be protected against damage from insertion or removal of struts or tie wires.

Lifting lugs shall be placed on all metal pipe 30" (762 mm) dia. and larger to facilitate moving pipe without damage to exterior or interior coatings. Prior to placing backfill, damaged areas of coupling bands and pipes shall be given a coating of a bituminous material specified in Federal Specification WW-P-405. Pipe on which bituminous coating has been damaged to such an extent that satisfactory field repairs cannot be made, shall be removed and replaced without additional cost to the City. Vertical elongation, where indicated, shall be accomplished by side-fill compaction, factory elongation, or an approved method of strutting, as indicated. Suitable markings or properly placed lifting lugs shall be provided to insure placement of factory elongated pipe in a vertical place.

1001.4.3 Structural-plate steel pipe, pipe arches, and arches: Structural plate shall be assembled in accordance with instructions furnished by the order of assembly. Bolts shall be tightened

progressively and uniformly, starting at one end of the structure after all plates are in place. The operation shall be repeated to insure that all bolts are tightened to meet the torque requirements of 200 foot-pounds plus or minus 50 foot-pounds.

Any power wrenches used shall be checked by the use of hand torque wrenches or long-handled socket or structural wrenches for amount of torque produced. Power wrenches shall be checked and adjusted frequently as needed, by reason of type or condition, to insure proper adjustment to supply the required torque.

1001.4.4 Structural-plate aluminum pipe, pipe arches, and arches: Structural-plate shall be assembled in accordance with instructions furnished by the manufacturer. Instructions shall show the position of each plate and the order of assembly. Bolts shall be tightened progressively and uniformly, starting at one end of the structure after all plates are in place. The operation shall be repeated to insure that all bolts are torqued to a minimum of 100 foot-pounds on aluminum alloy bolts and a minimum of 150 foot-pounds on galvanized steel bolts. Any power wrenches used shall be checked by the use of hand torque wrenches or long-handled socket or structural wrenches for the amount of torque produced. Power wrenches shall be checked and adjusted as frequently as needed, by reason of type or condition, to insure that they are in proper adjustment to supply the required torque.

1001.5 NOT USED

1001.6 NOT USED

1001.7 JOINTS.

1001.7.1 Concrete Pipe

1001.7.1.1 Gasket Types. The gaskets and the receiving portions of the concrete pipe shall be thoroughly cleaned of any foreign matter and shall be handled carefully to prevent damage to either jointing surface. Immediately after the pipe is lined up in the ditch ready to couple, "o-ring" gaskets and receiving portion of the concrete pipe shall be thoroughly lubricated with flax soap or other non-petroleum lubricant recommended by the manufacturer.

Rope type and flexible plastic gaskets require a primer to be applied to tongue of pipe prior to installation of gasket. Type of primer shall be as recommended by manufacturer of gasket. After primer has dried, remove paper wrapper from one side of gasket; apply plastic gasket strips end-to-end to the leading edge of the tongue of each pipe joint, forming a continuous gasket around the entire circumference of the pipe joint. Sufficient pressure shall be applied in making the joint to assure that the joint is home and evidence of a slight squeeze out of the plastic gasket.

For concrete pipe to be jointed with "o-ring" gasket, a mechanical means shall be used to push or pull the pipe together. A mechanical means shall be any arrangement of come-along, winch, jack, lever or power equipment that can exert sufficient shoulders of the first several coupled pipe shall be checked to determine the proper normal spacing. This distance shall not be exceeded in any case for the balance of the entire installation. The mechanical force shall be maintained until the pipe has been partially backfilled and tamped to hold the pipe and prevent an excessive gap between the shoulders.

1001.7.1.2 Mortar Joint, T & G. Mortared joints shall be formed in the following manner. The first section of pipe downgrade shall be bedded to the established line and grade with the groove up grade. The groove shall be carefully washed with a wet brush and the bottom half of the groove end buttered with mortar. A shallow excavation shall be made underneath the pipe at the joint; this space shall be filled with mortar into which the ends of the first and second sections of pipe shall bed when laid. The tongue of the next section shall be cleaned with a wet brush and a layer of mortar shall be applied to the top half of it. The tongue end of the second pipe shall then be fitted into the groove end of the first pipe until the mortar is squeezed out onto the inner and outer surfaces of the pipe. The inner surface of the pipe at the

joint shall then be brushed smooth with a long-handled brush, and the outside shall be pointed up with a bead of mortar.

Prior to forming the joint, a band, consisting of a single thickness of cheese cloth not less than 8 inches wide, shall be placed under the joint so that, when the joint is completed and the bead is made, it can be brought completely around the joint and lapped or tied at the top as directed by the Engineer. The cheese cloth diaper shall be dipped in portland cement mortar just prior to placement. Paper meeting the approval of the Engineer may be substituted for cheese cloth.

Typing or lapping the diaper shall be completed in 4 or 5 lengths behind the laying operation in order to prevent movement of the pipe and consequent loosening of the diaper. The purpose of the diaper is to hold the cement mortar band in place while curing. The cement mortar band held in place by the diaper shall have a thickness of not less than ½ inch at the joint. The cement mortar band shall be cured with a covering of moist-earth, sand, canvas or burlap. The joint shall be kept thoroughly wet until backfilled. No backfilling shall be placed until the joint materials have been placed and the completed section inspected and approved. Walking or working on the completed pipe, except as may be necessary in tamping or backfilling, will not be permitted until the trench has been backfilled to a height of at least one foot above the top of the pipe.

1001.7.1.3 Mortar Joint, Bell & Spigot. Bell and spigot pipe shall be laid with the bell end upgrade. All joints in bell and spigot pipe shall be sealed with cement mortar. The mortar shall consist of one part portland cement, two parts sand and sufficient water to give the proper consistence. After each section of pipe has been laid, the lower portion of the bell shall be filled with mortar and the succeeding section laid in place so that the inner surface of the two sections are flush. The remainder of the joint shall be solidly filled with mortar and neatly troweled and finished to a 45 degree level beyond the edge of the bell forming a continuous ring around the pipe. The inside of the joint shall be wiped clean and smooth.

1001.7.2 Corrugated Metal Pipe. Connection bands shall be installed in such a manner as to provide secure and tight joints. The bands shall overlap each pipe section equally, with corrugations of both band and pipe sections matching, and bolts in connection bands shall be firmly tightened.

1001.7.3 Jointing Vitrified Clay Pipe. The surfaces of the joints shall be wiped free of dust, dirt, gravel, sand or other foreign materials, both before and after the application of the lubricant sealer. The vitrified clay pipe with the pre-molded plastic joint shall be connected by first brushing upon the mating surface the proper lubricant sealer recommended by the pipe supplier. The spigot end shall then immediately be centered on grade into the bell end of the last of a moderate force by a pry or lever device.

The pipes shall be joined no later than five minutes after the application of the lubricant sealer. Once the coupling has been assembled, the pipe may be moved to correct for alignment or grade without subsequent damage to the joint. Should a cracked socket be detected, the cracked joint of pipe shall be removed and replaced immediately before the lubricant sealer completely sets up.

1001.7.4 Jointing Ductile Iron Pipe. The joints for ductile iron mechanical joint pipe shall be made in accordance with the manufacturer's directions, and all joint materials shall be furnished with the pipe by the pipe manufacturer. All joint surfaces shall be thoroughly cleaned before making up the joint. Rubber gasket seal type joints in ductile iron bell and spigot pipe shall be installed in accordance with the pipe manufacturer's directions, and all joint materials shall be supplied with the pipe.

1001.7.5 PVC Pipe. PVC pipe shall be in accordance with the manufacturer's printed instructions. Solvent cement shall be in accordance with manufacturer's recommendations. Jointing of pipe shall be in accordance with the manufacturer's printed instructions. Gaskets shall be furnished by manufacturer of pipe. The spigot end shall be inserted to proper depth of socket.

1001.7.5.1 Injection Sealed PVC Pipe. Injection seal jointing of PVC pipe shall be in accordance with the manufacturer's printed instructions which shall be furnished to the Engineer. The spigot end shall be inserted to the full depth of the socket as indicated by the home mark and driven into the locking taper as recommended by the manufacturer. The ports in the socket end shall be positioned so as to allow observance of flow of the adhesive from the exhaust port. The adhesive compound shall be injected until air is no longer observed to bubble from the exhaust port. Escape of adhesive compound beyond the retainer ring shall be cause for rejection of the joint.

1001.7.6 Copper Pipe. All copper lines shall have flared compression type joints. Joints shall be made in strict conformance with the pipe manufacturer's written directions.

1001.7.7 Joint Wrap. All joints in concrete or metal pipe shall be wrapped with a geotextile fabric for a minimum of 12 (twelve) inches on either side of the joint or connecting band. Ends of the fabric shall be lapped at least 10 (ten) inches. The edges and end of the fabric shall be suitably secure for the entire circumference of the pipe. The geotextile fabric shall have a minimum AOS of 70 or greater.

1001.8 BACKFILL. No backfilling work shall be done until the pipe to be covered has been inspected. The contractor shall be responsible for the stability of all backfill made under the contract until final completion of the work and shall bear the expense of replacing any portions which have become displaced due to carelessness or negligent work on the part of the Contractor or to damages resulting from natural causes.

Backfilling of the pipe shall start as soon as the inspector considers the joints to be satisfactory. If, in the opinion of the project manager, the excavated trench material is unsuitable for backfill, a select material will be brought in and compacted to 95% proctor density (AASHTO T-99) at no direct pay. The utmost care shall be taken not to disturb the pipe by throwing the backfill material upon them from the bank above, or not to shift a pipe from its proper position by careless or unskilled ramming around it or by unequal filling on the side. Equal and similar care shall be exercised in filling up to 8 inches (21cm) above the top of the pipe.

Where a trench is within the limits of the streets and alley rights of way, the density of the compacted material shall not be less than 95% as determined by Method A of AASHTO T-180. Tests shall be conducted in these areas as deemed necessary by the Engineer. Where the trench is in open ground, the pipe will be backfilled to 95% proctor density to a point 12 inches above the top of pipe. The remaining backfill will be placed in 8 inch lifts compacted to 90% density.

In those portions of the backfill which are adjacent to structures or are, for other reasons, inaccessible to the equipment used, the Contractor shall use mechanical tampers approved by the Engineer to obtain the specified density. Backfill will be to a point 12 inches above the top of pipe and may consist of finely divided native material stockpiled from the excavation if deemed suitable by the project manager.

1001.9 METHOD OF MEASUREMENT.

1001.9.1 Pipe In Place. Installed storm drain pipe will be paid for at the contract unit price bid per linear foot according to the various sizes, types, classes, and depths, which price and payment shall constitute full compensation for furnishing, hauling, trenching, bed preparation, laying, jointing, standard bedding and backfilling the pipe and fittings complete, and for furnishing all equipment, tools, labor and incidentals (including cleaning and testing) necessary to complete the item in accordance with the plans and specifications. Measurement for the length of pipe, culverts and end sections will be the actual linear footage in place and complete within the limits shown on the plans for all depths, measured along the top center line of the pipe. Measurement into structures will be to the inside face.

No additional payment will be made for excavation, sheeting and bracing (except extra sheeting and bracing left in place and paid for under other items), backfill and compaction and removal of excess earth. No direct payment shall be made for dewatering, including all pumping, well pointing and other necessary

operations unless specifically required by the project engineer.

1001.9.2 Concrete Cradle and Granular Foundation. If required, and approved by the Engineer, these items shall be measured by the cubic yard in place.

1001.10 BASIS OF PAYMENT. The accepted quantities as measured above will be paid for at the contract unit price as follows:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1001 (1)	Pipe Line in Place (size, type, class or thickness)	Linear Foot
1001 (2)	Concrete Cradle*	Cubic Yard
1001 (3)	Granular Foundation*	Cubic Yard

* - Only if required, and approved by the Engineer

SECTION 1002

EXCAVATION AND BACKFILL

1002.1 GENERAL. This section covers the excavation and backfill of water mains, sanitary sewer lines, force mains, manholes and other related appurtenances. The Contractor is responsible for complying with all State, Parish and City ordinances in notifying "LOUISIANA ONE CALL" (811) to assure that all underground utilities in the vicinity of the work are located and properly marked before undertaking excavation work of any kind.

1002.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only and the most recent edition shall be used.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 99	Standard Method of Test for Moisture-Density Relations of Soils

ASTM INTERNATIONAL (ASTM)

ASTM C150	Standard Specification for Portland Cement
ASTM C403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

OSHA- 29 CFR 1926.651	Trench and Excavation Safety

1002.3 MATERIALS. Only approved soil materials, as indicated on the plans, specifications and approved submittals are to be used for backfilling. Any soil that exceeds the EPA contamination guidelines is unsuitable for backfilling and shall not be used. Other types of materials unsuitable include those that do not comply with the requirements set forth in the plans and specifications, these include but are not limited to: man-made fills, trash, refuse, or backfills from previous construction, material classified as satisfactory which contains root and other organic matter, frozen material, and larger stones. Unsuitable soils are defined in ASTM D 2321 as Class IV and Class V soils. Class V soils are clays and silts, while Class IV soils are predominantly fine grained soils. Class IV soils, exhibiting low liquid limits, may be utilized upon authorization of the Engineer based on recommendation from a registered Geotechnical Engineer in

the State of Louisiana indicating acceptable use. All backfill material must be free from roots, wood, scrap material, frozen material rocks, and stones - larger than three (3") inches in dimension, muck as described in Section 306 and other unsuitable material. When the type of backfill material is not indicated on the drawings or is not specified, the excavated native material may be used, provided that such material consists of loam, clay, gravel, or other materials that in the written opinion of the Engineer, are suitable for backfilling.

Should there be a question as to the suitability of using excavated soil for backfill; the Engineer may require a soil test before permitting the excavated soil to be used as backfill. Contractor shall consult a geotechnical engineer to determine the type of material, the classification of the material, and the particle size of the material. Site-excavated material may not be used without Engineer's approval of the geotechnical engineer's findings. Excavated material should be of a quality that will compact, will not settle or shrink and will not become unstable when wet. The borings or soils report provided by the City in support of the contract documents shall indicate properties of the native soils. Also, should the excavated soil be too wet for backfilling, the Contractor shall make a reasonable effort to spread and dry it, or otherwise mix in additional dry soil to make the excavated soil suitable for backfilling.

Prior approval must be obtained from the City before bringing in select backfill to replace the excavated fill.

Anytime the Contractor brings in imported backfill, he is required to furnish soil compaction test data from a certified soil testing laboratory at his expense. Copies of soil test data are to be submitted to the City for approval. All sand used for backfill, meeting the gradation requirements for "Fine Granular Material", shall be clean, graded from fine to coarse, not lumpy or frozen, and free from slag, cinders, ashes, rubbish, or other material that, in the opinion of the Engineer, is objectionable or deleterious.

1002.3.1 Coarse aggregate material shall conform to the following standards

Gradation U.S. Sieve	% Passing
3/4"	100
1/2"	80-95
3/8"	25-60
#4 Sieve	5-15
#10 Sieve	Min-5

1002.3.2 Fine granular material shall conform to the following standards

Gradation U.S. Sieve	% Passing
1/2"	95-100
No. 10	75-100
No. 200	0-10

1002.3.3 Select Material. Select material shall be classified as low plasticity soil type as outlined in ASTM D2487 soil classification code and is defined as dry fine granular material, or native soil, consisting of sand, sandy loam or loam free of excessive clay (less than 5%) and excessive moisture. Type IV material may not be used unless approved by Engineer as per paragraph 1002.3 Materials. Backfill material shall be placed at an optimum moisture content determined in accordance with DOTD TR 415 or TR 418 in layers not exceeding eight (8") inches compacted thickness. The material's cohesion shall be in the range of 5 to 15 Pl, and when wet, it should not form mud or muck.

1002.3.4 Finely Divided Material. Finely divided material shall be defined as dry, imported soil, if suitable as backfill and with no more than 10% rocks and stones that are less than two (2") inches in

diameter.

1002.3.4.1 Flowable Fill. Flowable fill, when approved by the Engineer, shall be pumped in the trench excavation by ready mix concrete truck. Slump will not be generally tested, since the slump should exceed eight (8") inches. Bentonite can be added to improve the flow characteristics of the pump flowable fill through the delivery hose. Since this product initially is fluid, proper containment must be considered to avoid displacement or stressing existing structures until initial set is achieved. Since this will displace any existing sludge or wastewater, the contractor must have pumping ready to dispose of the sanitary wastes into a proper sewer and to keep the pump flowable fill out of functioning sewers.

Typical Mix Design Pump Flowable Fill 50 psi @ 28 Days

Cement	ASTM C150, Type I	50 lbs.
Fly Ash	ASTM C618	200 lbs.
Fine Aggregate	Concrete Sand	2,900 lbs.
Water		60 gal.

After 3 days, the flowable fill shall have at least 20 psi strength. After 28 days, the flowable fill shall have at least 30 psi strength as per ASTM C403 (See Section 1002.3). The material should achieve penetration resistance numbers from 500 to 1500. Testing for flowable fill shall be at the Engineer's or Inspector's direction. Material not placed within three (3) hours after loading, or material which has obtained an initial set, may be rejected and removed from the site.

Material placed by this method can be used in lieu of soil compacted to 95% Standard Proctor Density. Applications include trench backfill (not in bedding), foundation backfill, structural excavation backfill, and abandonment of underground piping.

1002.3.5 Concrete Arch Encasement. Concrete for arch encasement shall consist of Class "D" Concrete as defined in Section 201. Reinforcing Steel shall be grade 40 as further described in Section 201.2. Minimum bars shall be #5's 6" on center, each way (O.C.E.V). Construction standard shall be as per STANDARD PLAN No. 2000-2. Any metal bands and/or clips used to secure boots, fittings, etc., shall be protected with plastic or other suitable fabric wrap prior to pouring concrete encasement.

1002.3.6 Circumferential Concrete Encasement. Concrete for circumferential concrete encasement shall be a minimum of Class "R" as defined in Section 201. Two Concrete Test Cylinders shall be provided for each 100 cubic yards of concrete placed, or as a minimum, one (1) test cylinder for each day of concrete work, if less than 100 cubic yards are placed in a day.

1002.4 CONSTRUCTION REQUIREMENTS.

1002.4.1 Partial Backfilling During Testing. When approved by the Engineer, pipe pressure and leak testing may be performed before completing backfill so that pipe joints are visible for leak detection. In such cases, backfill shall be placed over the pipe barrel between the joints to prevent movement.

1002.4.2 Trench Excavation. The trench shall be excavated to the required alignment, depth and width as specified herein and on the plans. All trench excavation shall be in accordance with the OSHA regulations and applicable local codes and ordinances. The Contractor should make use of "Trench and Excavation Safety (29 CFR 1926.651)", and "Trench Safety Systems", (See Section 1004) to assure the safety of the trench.

Sides and slopes of the excavation shall be maintained in a safe condition per the aforementioned safety codes until completion of backfilling. Sheet piling and/or shoring may be necessary where sloping is not

possible because of space restriction or instability of material excavated. Trench excavation shall proceed in advance of pipe installation only as far as safe trench conditions can be maintained for workmen and only far enough ahead to achieve efficiency in pipe laying operations. The trench should be opened no more than one hundred feet (100'). ahead of where pipe is being laid in the trench.

The sides of the trench shall be cut and sloped in order to prevent caving. Where stable soil conditions exist and OSHA regulations permit, the trench sides may be cut as nearly vertical as possible from the bottom of the trench to a point twelve (12") inches above the top of the pipe when it is laid to grade. The trench width from its bottom to an elevation twelve (12") inches above the top of the pipe shall not exceed the maximum width as specified in STANDARD PLAN No.2000-1 or twelve (12") inches beyond the pipe outside diameter on each side. When timber supports, sheeting, bracing and appurtenances are required, the trench width will be adjusted to permit the placing of these items. In unstable wet, saturated, or caving ground, the trench shall be adequately sheeted and/or braced so as to prevent slides or cave-ins and to protect workers. Damages and extra work caused by the Contractor's failure to properly protect trench beds and walls shall be at his expense. (See Sheeting and Shoring Requirements, Section 1004). The bottom of the trenches shall be accurately graded and bedded in accordance with the City's STANDARD PLAN, (3000-1, 3000-2 or 2000-1) for the particular pipe being laid. The bedding is to provide uniform bearing and support to each pipe section along its entire barrel length. Accordingly, the Contractor shall excavate depressions for pipe bells. These depressions shall be dug only after the trench bottom has been graded and bedded. The Contractor must assure that the pipe weight is evenly distributed along its full length and that neither the bell end nor the spigot end is unevenly loaded, in order to avoid stressing the pipe and to minimize the risk of pipe leaks and failures.

Care shall be taken not to excavate below the depths indicated on the construction plans. Excavations exceeding planned depths shall be backfilled, at Contractor's expense, with granular fill, to return the trench to required depths. When the Engineer requires, in writing, the trench to be excavated wider or deeper than shown on the plans, due to unsuitable soil, muck or overly wet conditions, the Contractor shall comply by excavating to the depth required. Additional excavation required due to unsuitable soils not identified by the Contract Documents shall be addressed as per the Owner's standard practices for "Change Order". He or she shall then backfill with foundation material, and if necessary, shall place it over geotextile fabric.

If rock excavation is not quoted in the Contractor's bid and if rock is encountered, the City shall allow a payment not to exceed the following: Up to \$_____ per cubic yard of rock excavated from an open trench.

1002.4.3 Backfilling and Compaction. The Contractor is required to use compaction equipment specifically designed for compacting (Roller, Sheeps Foot, Vibratory Plate, Rammers and Jumping Jack Tamps) the work in the lift heights as detailed herein unless otherwise stated in the plans. More stringent requirements shall govern. This includes compacting pipe trench bedding and haunching areas, as well as the trench above the pipe line. Backhoe and front-end loader buckets shall not be used for compaction, as they are not designed for the purpose. Any compaction work accomplished by such methods shall be proven to meet compaction requirements.

The Contractor is responsible for protecting the trench and compaction work at all times. This includes maintaining the compaction integrity of trench bedding and walls by erecting diversion dams or ditches to keep rainwater out of the trenches. Once backfilling and compaction have been started, any work required to remove and replace soil saturated by rainwater run-off shall be at the Contractor's expense.

1002.5 FILL AND BEDDING MATERIALS.

1002.5.1 Foundation Fill Material. When required by the Engineer, foundation fill material shall be placed in the trench using coarse aggregate fill over geotextile fabric. The foundation zone encompasses the area below the pipe embedment zone. The foundation fill material shall be brought up from the trench bottom. The Engineer may require the use of filter fabric to restrict migration of fines through the voids

of the coarse aggregate material. The sieve shall be determined by the Engineer.

1002.5.2 Pipe Embedment. The pipe embedment zone encompasses the bedding layer, the haunching area, and the initial backfill. The final backfill encompasses the area above the pipe embedment zone to the ground, subgrade or grade of the roadway, or other limits as shown on the plans.

1002.5.3 Bedding Layer (Below the Pipe). Bedding material will vary depending on the type of pipe being laid. The contractor must first install the bedding material as called for in the construction plans or otherwise as shown on the STANDARD PLAN, (3000-1, 3000-2 or 2000-1). The bedding layer shall be brought up to the proper grade required for the bottom of the pipe. It shall have recesses scooped out to receive the pipe bells. The pipe should then be placed on the graded bedding. Each pipe section shall have uniform bearing on the trench bedding. When required to maintain the pipe on the established grade line, adjustment will be made by scraping away or filling in with bedding material. Wedging or blocking up pipe will not be permitted. The pipe must be uniformly supported.

Over excavation and installation of bedding materials for water pipe, as shown on STANDARD PLAN No. 3000-1, shall be required when unsuitable soils, rocks, stones, or construction debris is encountered in the trench bottom. Unsuitable soils are defined in ASTM D2321 as Class IV and Class V soils. Class IV soils, exhibiting low liquid limits, may be utilized upon authorization of the Engineer, but only after submission of a signed and sealed report by a Geotechnical Engineer registered in the State of Louisiana. Additional excavation required due to unsuitable soils not identified by the Geotechnical Report shall be addressed as per the City's standard practices for "Change Order". Bedding shall not be used as foundation fill material. Bedding shall be required for all water pipes when rock and stones greater than 2" are encountered in the trench bottom. Bedding for flexible pipe, (defined as all plastic pipe) shall also be required for Class IV and Class V soils.

1002.5.4 Haunching Area (Bottom of Pipe) to Springline. Haunching material will vary depending on the type of pipe being laid. The Contractor must install the haunching material as called for in the construction plans or as otherwise shown on STANDARD PLAN (No. 3000-1, 3000-2, and 2000-1). Backfill material should be worked under the sides of the pipe to provide satisfactory haunching.

Haunching area for gravity sewer pipe shall consist of coarse aggregate fill. It shall be placed after the bedding layer has been installed. The coarse aggregate backfill shall be carefully rodded to provide support under the pipe as shown on STANDARD PLAN No. 2000-1.

Haunching for water main pipe shall require tamped backfill of native soil or alternatively fine granular backfill. Haunching shall provide the lower part of the pipe with support as shown on STANDARD PLAN No. 3000-1.

1002.5.5 Initial Backfill. Initial backfill will be to a point twelve (12") inches above the top of the pipe and may consist of finely divided native material stockpiled from the excavation, if suitable, as outlined in paragraph 1002.3. Alternatively, fine granular material may be substituted. Alternative backfill, if specified in plans, may be used in lieu of these materials. Initial backfill shall be compacted to 95% maximum density (AASHTO T-99).

1002.5.6 Final Backfill. The Contractor shall make the final backfill from a point twelve (12) inches above the pipe to existing grade, sub-grade or base as required. The degree of backfilling compaction density shall be governed by whether the pipeline is in a load or non-load bearing area or in open country. Water settlement of backfill material above the required pipe embedment will not be permitted unless special permission is given, or the Engineer otherwise requires it.

1002.5.7 Backfill Using Imported Materials. Native backfill, which in the opinion of the Engineer, is not suitable for use as final backfill, may be replaced with imported material as authorized in writing by the Engineer. Select material or finely divided material may be substituted, as authorized by the Engineer, after inspection of the soil at the source. Payment for this material shall be received only upon submission

of proper invoices or vouchers, the prices stipulated in this contract for work delivered or rendered and accepted, less any deductions provided in this contract. Unless otherwise specified, payment shall be made upon acceptance of any portion of the work delivered or rendered for which a price is separately stated in the contract under the backfill line item.

1002.5.8 Final Backfill Compaction. The entire trench depth shall be compacted in six (6") inch lifts, to 95% density, by standard proctor by the Contractor. Plumbers will also be responsible for compaction when making taps, setting meters or repairing service lines. If compaction requirements indicated in the plans are more stringent, then they shall govern.

In open country, where minor settlement of final backfill can be tolerated, the Contractor shall compact to a dry density of 90% AASHO T-99 or to the insitu density of the soil, or as approved in writing by the Engineer.

1002.5.9 Compaction Testing. Compaction testing will be performed by an independent certified testing company, hired and paid for by the City. The minimum number of backfill compaction tests shall be as follows:

1. In State and Parish right-of-ways, the number and location of compaction tests shall be as prescribed in applicable State or Parish specifications. Otherwise, it shall be as specified below.
2. In City and other utility company right-of-ways and servitudes, compaction testing shall be two per each 1000 linear feet, or fraction thereof, of pipe length per each 2 feet of vertical depth above the pipe spring line as detailed in STANDARD PLAN No. 2000-1 and 3000-1.
3. Compaction testing of the bedding layer prior to installing pipe.
4. In no case, shall the number of compaction tests be less than four per total trench length and depth.
5. In addition, testing will also be at the City's discretion. Contractor shall coordinate with the City or the Engineer in making necessary accommodations for the tests.

The Contractor shall provide proctor density samples for any imported soil or soils he intends to use as backfill. Additional proctors may be requested if soil conditions are determined to be different from those that were previously reported, listed in the Contractors bid documents and/or submitted as samples.

1002.6 DISPOSAL OF EXCAVATED MATERIALS. Excavated material shall be stockpiled near the work and used as needed for backfill. Unsuitable or excess material shall be disposed of off-site, as approved by the Engineer.

1002.7 MEASUREMENT AND BASIS OF PAYMENT. Work covered by this specification is considered incidental and shall not be paid as a separate item, but shall be included in the pipe or manhole bid items, as applicable. The Contractor shall not be paid for any excavation, backfill and/or bedding amounts that exceed the lengths, widths or depths detailed in the construction plans or in these specifications, unless prior written approval has been obtained from the Engineer. Any over-excavation, by the Contractor, in complying with Section 1004, shall not be measured or paid and shall be considered to be at the Contractor's convenience and expense.

The excavation and backfill must be authorized by the Engineer, in writing, prior to commencement of the work. The foundation material quantity shall be measured at maximum trench width, times length, times the depth of the foundation layer. Foundation material shall be paid for based on the actual cubic yard volume installed in the field and per the unit rate detailed in the Contractor's bid proposal. Payment for foundation shall include excavation, backfilling and geotextile, as appropriate for the work involved.

Imported backfill material shall be measured as maximum trench width, times depth, times trench length, minus pipe and appurtenance, and minus foundation and bedding fill material as measured in cubic yard volumes. Imported backfill shall be paid for based on the actual volume of cubic yards installed in the field and per the unit rate detailed in the Contractor's bid proposal. The payment shall include importing costs, placement and compaction as necessary; otherwise, this shall be considered incidental to the pipe installed.

Measurement for concrete cradle and concrete arch encasement shall be on a cubic yard basis, excluding bedding, foundation material, pipe and appurtenances. If measured as a bid item, payment for concrete cradle or concrete arch encasement shall be full compensation for installation complete in place and include incidentals as necessary; otherwise, this shall be considered incidental to the item of pipe being installed.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
I002(1)	Over excavation for unsuitable and previously unidentified soil (changed condition)	Cubic Yard (C.Y.)
I002(2)	Foundation layer excavation/backfill	Cubic Yard (C.Y.)
I002(3)	Excavation and backfill	Part of pipe installation unit cost

SECTION 1003

ABANDONMENT OF EXISTING WATER MAIN AND SANITARY SEWER FACILITIES

1003.1 GENERAL. This section details the work to be performed to abandon existing water and sanitary sewer system components.

1003.2 MATERIALS. Materials described herein and on the construction drawings shall be supplied by the Contractor, subject to the approval of the Engineer.

1003.3 CONSTRUCTION.

1003.3.1 Water Mains. Water mains designated for abandonment on the drawings, shall be abandoned in place by cutting and plugging the pipe ends at locations shown on the plans. This includes completely draining the entire water main, cutting and installing water tight plugs at the disconnected water source. Unless otherwise indicated on the drawings, pumped grouting of the entire length of abandoned water mains is not required.

1003.3.2 Manholes. Manhole rings and covers shall be removed from abandoned manholes and delivered to the City's facility at 2139 Greenwood Road, Shreveport, Louisiana. All pipes entering the manhole shall have a section two (2') feet or more in length cut and removed on the external side of the manhole. Access to cut and remove pipe section shall be achieved via excavation. The end of the abandoned sewer main, the pipe cutout in the manhole and the two (2) foot voided section, are all to be completely filled and plugged with concrete. The concrete plug should be sized larger than the original pipe diameter so that a water tight seal is achieved in the abandoned pipe and in the manhole. Any remaining or connecting operational sewer system must be protected from "Inflow and Infiltration" problems that may result if abandoned sewer systems are not properly plugged and sealed.

The manhole structure shall be removed to a level two feet below natural grade or to the proposed grade shown on the plans. The removed material shall be disposed of in contractor-selected disposal areas approved by the City prior to disposal. Abandoned manholes shall be filled with select material compacted to 95% Standard Proctor Test. The site shall be finished and seeded as required.

1003.3.3 Gravity Sewer Mains and Force Mains. Gravity sewer mains designated for abandonment in open areas shall be cut, filled with pumped grout and sealed with water tight plugs at the locations shown on the plans. Those that are connected to manholes shall be cut, filled and plugged as detailed in the paragraph above. Force mains abandoned in open areas shall be cut and plugged in the same manner as detailed in the paragraph above for water mains. Force mains abandoned at manholes will be cut, filled and plugged as detailed above in paragraph, 1003.3.2. Any water present in the mains shall be pumped before being abandoned and disposed of into the nearest sanitary line (or as otherwise approved by the City) and in full accordance with local and State regulations. Contract bid should include the cost for necessary pumping, supplying and installing flowable fill or grout unless otherwise indicated on the plans.

1003.3.4 Water Valves and Fire Hydrant. Water valves and fire hydrants designated for abandonment, must be removed from their mains and delivered to the City's facility at 2139 Greenwood Road, Shreveport, Louisiana. If the water valve cannot be removed, it should remain in the open position prior to removing the valve box and filled with select fill or concrete.

1003.4 MEASUREMENT AND BASIS OF PAYMENT. The abandonment of existing water and

sewer systems shall be measured on a per linear foot basis for all work completed and accepted in accordance with the Contract Documents. Payment shall be at the contract lump sum price and shall be full compensation for all plugs, compacting non-shrink grout, select fill, concrete, other materials, labor, equipment, tools, pumping, and supervision necessary to complete the work according to the plans and these specifications.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1003(1)	Abandonment of Existing Water and Sewer Systems	Linear Foot (LF)

SECTION 1004

TRENCH SAFETY SYSTEMS

1004.1 GENERAL.

This section details the materials and construction for furnishing and installing a trench safety system, including sheeting and shoring. Applicable and non-conflicting portions of this Specification, Sections 1002, 1005, and 1006 apply as appropriate to provide a complete and proper system. This requirement may apply to trenches five (5) feet or more in depth, or as specific job site soil and/or water moisture conditions warrant. Trenches less than five (5) feet in depth, need not be sheeted and braced, except where the trenches are in close proximity to existing structures or subsurface structures or when the Engineer specifically prohibits the use of a non-sheeted trench in writing.

1004.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only and the most recent edition shall be used.

ASTM INTERNATIONAL (ASTM)

ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A328	Standard Specification for Steel Sheet Piling
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A690	Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

OSHA 29 CFR 1926	Subpart P- Excavation, Trenching and Shoring

1004.3 PROCEDURES. The Contractor shall submit a project specific Trench Safety Plan for all portions of the work with trenches deeper than five feet (5') for the Engineer's review. If exceptionally deep trenches are required or if highly unstable soil conditions exist, and/or if OSHA regulations dictate, the trench safety plan may have to be designed and sealed by a Louisiana registered Professional Engineer who has appropriate experience in soil mechanics and structural engineering. The decision rests with OSHA and/or the Engineer. The Trench Safety Plan submittal shall be in accordance with Section 4300, and other pertinent sections of the City's Standard Specifications.

The plan shall be detailed to the extent that it shows the proposed limits (to the nearest foot) of the various types of trench safety systems the Contractor proposes to use. Shop drawings which include, but not limited to, details of types of sheeting, bracing, shoring and all other temporary or permanent supporting structures shall also be provided. The Contractor shall be responsible for obtaining soil sample borings and detailed geotechnical analyses as required to develop the plan at his expense. The plan will be forwarded to the City,

and the Engineer for use in monitoring the Contractor's trench safety activities.

The Contractor shall be responsible for complying with and enforcing safety regulations that are applicable to his work. Inspector's monitoring of the trench safety activities does not relieve the Contractor from any or all trench safety responsibilities. Neither does it release him/her from any liability for property damage or bodily injury that arises from use of the trench safety plan. Use of the plan does not absolve the Contractor for any negligence in performance of contract work, or from Engineer's failure to note exceptions to the safety plan.

In cases where sheeting and bracing will not adequately protect structures from damage and settlement, the Contractor will be required to use such methods as are necessary to safely support and maintain adjacent and abutting property and structures and to maintain the work safe to life, limb and property. Changes in the Trench Safety Plan after initiation of construction, both for the Contractor's convenience or in response to unforeseen or differing conditions, are not cause for extension of time or change order, and will require the same implementation process as the original plan.

1004.4 MATERIALS. All trench materials and products shall be suitable for their intended use, and shall be free from injurious defects. Steel sheeting materials shall conform to the requirements set forth by ASTM A36 and all other applicable requirements of ASTM standards. All steel sheet piles, timber piles and shoring materials, etc. shall comply with the specifications and standards set forth by State and Local Regulatory agencies, as well as, OSHA (29 CFR 1926 Subpart P). Where these standards differ, the more stringent standards shall apply. Provide suitable shoring and bracing materials such as sheet piling that conform to ASTM A328 or ASTM A572 or ASTM A690, unless approved otherwise. All timber shall be structural grade with minimum allowable flexure strength of 1100 psi. Timber lagging shall be at least 3 inches thick and free of large or loose knots. Materials should be in serviceable condition. If the Engineer finds the materials in unserviceable condition, the Contractor shall replace the materials before carrying out further work.

1004.5 CONSTRUCTION REQUIREMENTS. The design of temporary excavation support shall be the responsibility of the Contractor. The design calculations and drawings shall be prepared, stamped and signed by a Professional Engineer registered in the State of Louisiana who is experienced in designing similar support systems. Requirements for trench shoring and bracing shall comply with the latest provisions of the OSHA regulations (29 CFR Part 1926) and any applicable local codes and ordinances. These shall be the minimum requirements for trench safety. Where hazardous trench conditions exist as per the OSHA Regulations and or Safety Plan, adequate sheeting and/or shoring shall be provided by the Contractor so as to maintain the trench free from slides or cave-ins and safe for workmen. Review and field monitoring by the Engineer does not relieve the Contractor of its responsibility for the work.

1004.6 As an alternative to sheeting, the Contractor may utilize a mechanical trench box, providing it meets OSHA requirements (OSHA 29 CFR 1926/1910 Subpart P-Excavations, trenching and shoring). Additional excavation, backfilling, and surface restoration required by the use of a trench box shall be at no additional cost to the City. Maintain shoring and bracing systems retaining earth on which the support or stability of existing structures is dependent. Such systems shall be left in place until completion of work. Contractor shall consult with the Engineer and obtain his concurrence before using the "Angle of Repose" method.

Methods of construction for excavation shall be such as to ensure the safety of the work, Contractor's employees, Engineer, City's employees and inspector, the public and adjacent property and improvements, whether public or private.

Where existing buildings, other utilities, streets, or other structures are close to the trench, adequate protection shall be provided by the use of sheeting and shoring to protect the structure from possible damage. Sheeting shall be provided (as per Contractor's design) to protect environmental habitat or sensitive areas (creeks, streams, etc.) or if soil will not allow adequate open trench installation within construction easement. In the case of streets or utilities, the Contractor may elect to remove the

street or utility provided the removal and subsequent replacement meets with the approval of the Engineer and the owner of the utility and/or structure. In all cases the Contractor is responsible for protecting public and private property and all personnel from harm or injury as a result of his work. The Contractor shall take adequate measures to protect existing utilities and environmentally sensitive areas including but not limited to active sewer, water, gas, electricity, creeks, streams, and at any other locations as specified in the plans. The repair of or compensation for damage to any such facilities shall be borne by the Contractor and at no cost to the City.

Sheeting shall be driven to a depth suitable to protect the construction and adjacent property. The shoring authorized and approved by the Engineer shall be left in place, and other items shall be removed in stages to prevent any settlement and or adverse effect on the adjacent base or pipe trench. See subsection 1004.8 of this specification for information regarding sheeting and shoring left in place.

The use of steel sheeting in trenches and subsequent removal will not be permitted except with written approval of the Engineer in each case. Where steel sheeting is allowed to be driven below the top of the pipe, the width of the trench must be great enough to allow a second set of wooden sheeting to be driven inside the steel sheeting. This wooden sheeting shall be driven before the excavation has been carried lower than the top of the pipe; it shall be driven, braced, and left in place in accordance with the requirements of the preceding paragraph. The steel sheeting shall not be pulled until the trench has been backfilled and compacted at least two feet above the top of the pipe. No additional payment will be made for temporary steel sheeting piling used in maintaining trenches.

1004.7 PILING. All piling shall be driven using only equipment that have current maintenance inspections and are certified safe for driving the specific piles that are required for the project. The equipment is to be operated by a duly licensed operator within the operating ranges and capacities established by the equipment manufacturer. A copy of certificates and licenses shall be kept on work site. The pile driving hammer shall be of sufficient capacity, size and type to be able to deliver consistent effective dynamic energy to adequately drive the pile to the required penetration and resistance depths.

Care shall be taken to avoid distortion, battering or wrapping the top edge of the pile. Any pile found to be defective or damaged or with faulty alignments after driving shall be removed and replaced by a new pile of equal or greater length, at no expense to the City. If the Contractor encounters an obstruction that prevents pile driving to the depth required, he/she shall submit a re-evaluation of the trench support completed by the Contractor's Engineer. The pile shall be cushioned against hammer damage by using cap blocks for a driving head. Unless otherwise approved by the Engineer, all sheeting and bracing shall be carefully removed when no longer needed. Care should be exercised so as not to endanger the construction, personnel, or property.

1004.8 SHEETING AND SHORING LEFT IN PLACE. When, in the judgment of the Engineer, removal of sheeting or bracing is likely to cause damage to pavement or property, the Engineer may order such sheeting and bracing left in place as he considers necessary. Neither the giving of such orders by the Engineer nor his failure or refusal to issue such orders shall in any way relieve the Contractor of the responsibility for damages to pavements or structures.

Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, that portion of the sheeting below the elevation of the top of the pipe shall not be disturbed or removed. Whenever timber or other sheeting is driven for the protection of trench walls in water-bearing soil, no portion of such sheeting below a level of 4 feet over the top of the pipe shall be removed.

Where the sheeting for the pipe is driven no lower than the top of the pipe, such sheeting may be withdrawn, provided that no sheeting is withdrawn until the trench is refilled as hereinafter provided to a point not less than two feet above the crown of the pipe. Where it is necessary to drive sheeting below the top of the pipe, and so ordered by the Engineer, such sheeting shall be driven down to a point not less than two feet below the bottom of the pipe and properly braced.

Bracing above the pipe shall be placed to allow at least one foot clear space between the bottom of the bracing and top of the pipe. The bracing above the pipe and all sheeting and bracing below the top sheeting shall be left in place. All sheeting and bracing above said bracing may be removed after the trench has been backfilled and compacted at least two feet above the top of the pipe unless ordered by the Engineer in writing to be left in place. Note that the depth and procedures mentioned here-in are general guidelines and the actual depth and procedures shall be based on the site conditions, geotechnical investigations or the Engineer's direction.

1004.9 QUALITY CONTROL BY CONTRACTOR. The Contractor shall engage and assign personnel to inspect the Trench Safety Systems to ensure that the systems meet OSHA and state requirements. The personnel can be a third party consultant with a minimum of five years experience in similar projects. The Contractor shall maintain a permanent record of daily inspections. If evidence of possible cave-ins, or slides is apparent, all work in that trench shall cease until the necessary precautions have been taken by the Contractor to safeguard personnel entering the trench. It is the sole duty, responsibility, and prerogative of the Contractor to determine the specific applicability of the designed trench safety systems to each field condition encountered on the project.

1004.10 MEASUREMENT AND BASIS OF PAYMENT. Trench Safety Plan will not be measured as a separate pay item unless it has been established as a separate pay item in the Bidding Documents. The cost of all sheeting and bracing not required to be left in place shall be included in the price bid for pipe of each size and depth, and the contractor will receive no additional compensation therefore.

1004.11 When authorized by the Engineer, sheeting and/or shoring left in place shall be measured by the board foot. The Contractor will be paid by separate pay item for all sheeting and shoring left in place at the written direction of the Engineer.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1004(1)*	Sheeting and/or Shoring Left in Place	Board Foot

* Only to be included if the Engineer deems necessary

SECTION 1005

TRENCH DEWATERING

1005.1 GENERAL. This section specifies the methods to be used for dewatering and maintaining dry trench conditions in order to assure that bedding material and pipes can be placed on dry, firm trench bottoms and to minimize sloughing and cave-in of trench walls. Dry conditions as referenced in this section shall be defined to mean a soil condition such that the in-place moisture content of the soil is no more than two percentage points above the optimum moisture content of the soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction.

1005.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only and the most recent edition shall be used.

Section 204	Temporary Erosion Control, Louisiana State Department of Transportation and Development's (LADOTD) Standard Specifications for Roads and Bridges.

Section 701	Culverts and Storm Drains, Louisiana State Department of Transportation and Development's Quality Assurance Manual, Embankment and Base Course.

1005.3 MATERIALS. The Contractor shall furnish, install and maintain all materials and equipment necessary to perform the dewatering operation, including draining, pumping, removing and disposing of ground/surface water from trenches, manholes, utility lines and other underground systems. In addition, the Contractor shall furnish silt dams, hay bales, ground covers, etc., as may be required to prevent and/or control soil erosion and silting of streams, ponds and bayous.

1005.4 CONSTRUCTION REQUIREMENTS. The Contractor shall implement dewatering work as needed to assure trenches, manholes, bore & jacking pits, etc. are dry and safe enough to execute the normal work of installing water and sewer systems per the plans. Surface water included in this work shall include water that appears on the surface as rainfall or snowmelt runoff, or ground water conditions below grades that appear at the surface in the form of weeps or springs. Control measures shall be taken by the time the excavation reaches ground water level in order to maintain the integrity of the in-situ material. The Contractor is required to place all pipelines, concrete work, bedding and base course in dry trench bottoms and to maintain the lines and grades indicated on the construction plans. The Contractor is to comply with Section 204 of the LADOTD's Standard Specifications for Roads and Bridges, and Section 701 of LADOTD's Quality Assurance Manual to protect State roadways and embankments from erosion and sloughing during dewatering operations. The Contractor shall be responsible for obtaining all applicable permits including but not limited to well permits, discharge permits prior to dewatering. Copies of all permits shall be submitted to the City.

1005.4.1 Wellpointing. Wellpointing will only be paid for when required and only when approved in advance by the Engineer, in order to keep the excavation dry, and the subgrade stable. As a general guideline, wellpointing shall normally be installed when the excavation is within a minimum of two (2) feet of the water table. However, if heavy construction equipment is to be operated, then the wellpointing may be required when the excavation is within five (5) feet of the water table. Actual soil conditions and other factors may influence the Engineer's final decision in this matter. Dewatering shall remain in continuous operation until the utility line or manhole has been installed, tested, backfilled and compaction is sufficient enough to assure that the weight of backfill material is adequate to overcome the in-ground water pressure that may dislocate the utility line or manhole. There shall be sufficient pumping equipment,

in good working order, available at all times, to remove water that accumulates in excavations to assure that a stable dry subgrade is obtained and maintained.

Where a pipeline crosses natural drainage channels, the Contractor shall take care to prevent damage and to avoid delaying the work. The Contractor is responsible for the satisfactory removal and disposal of surface water and for avoiding damage, erosion and silting to public or private property. Wellpoints shall be surrounded by suitable filter sands and no fines shall be removed by pumping. Pumping from wellpoints shall be continuous and standby pumps shall be provided. The Contractor shall be responsible for providing and installing sound barrier materials to encompass the pumping equipment to adequately muffle invasive noise to the public during operations.

1005.4.2 Dewatering. Dewatering of trenches, other than by wellpointing shall be accomplished by appropriate means elected by the Contractor; however, bedding material, pipe, manholes, etc. must not be placed in wet or unstable trenches. The Contractor shall submit a dewatering plan to the City detailing dewatering method and water disposal location. The Contractor shall obtain all applicable permits including any discharge permit. The trench shall be kept dry during trench bottom preparation and continually thereafter until the structure to be built, or pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation results. Soil that cannot be properly dewatered shall be excavated and hauled away to an approved disposal site. Suitable dry replacement soil shall be installed and tamped in place to the depth shown on construction plans, or as required to obtain a firm dry trench bottom. If required and approved by the Engineer, dewatering shall include a minimum of two (2) 4-inch Schedule 40 PVC, groundwater observation wells. These shall be strategically located, as required at structures or pipelines to determine the level of the water table during construction.

1005.4.2.1 Diversion of Surface Runoff. Surface runoff shall be diverted away from the trenches and into existing drainage systems, such as storm sewers, ditches or streams. Diversion of surface runoff shall be in such a manner as to prevent flooding of work area, streets and private property. Also silt dams, hay bales, other barriers and ground covers shall be properly placed to prevent downstream soil erosion and excess silting of bayous and ponds.

1005.4.2.2 Disposition of Water from Dewatering. All water removed from trenches by well pointing or other dewatering methods shall be pumped, piped or drained into existing drainage systems, such as storm sewers, ditches or streams. The disposition of water from dewatering operations shall be accomplished in a manner that will prevent the flooding of public or private property, and in accordance with the latest EPA - NPDES provisions for disposing of non-stormwater discharges into the municipal storm sewer system. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits. Contractors will comply with stipulations of required permits for disposal of water. Sediment and erosion control may be required by the City Engineer as site conditions warrant. Any sewer contaminated water shall be pumped back into sanitary sewer system unless otherwise stated in a permit.

1005.5 MEASUREMENT AND BASIS OF PAYMENT. Measurement and basis of payment for dewatering shall be included in unit price of pipe. Where additional or separate dewatering activities are approved by the Engineer, they shall be paid by the linear foot.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1005(1)	Dewatering	Linear Foot (LF)

SECTION 1006

BORING, TUNNELING AND PIPE JACKING OPERATIONS

1006.1 GENERAL. This section specifies trenchless construction of pipe by dry augering, slurry augering, and tunneling as designated on the plans or as described herein. The work shall include all excavation and backfill incidental to the installation.

The Contractor is responsible for furnishing an experienced crew, including properly trained operators and helpers. He shall furnish equipment that has the rated capacity for the size and length of the planned operation. The operator must have experience with the method utilized including at least five other jobs using the same or identical methods, equipment and pipe diameter, within +/- one pipe size from the designed pipe and of similar length. The Contractor is required to present written documentation, to the Engineer, verifying the experience and training level of the crews he intends to use for the boring, tunneling, or pipe jacking operation. The Contractor shall be responsible for water used in the boring operations. The Contractor shall be responsible for disposal of drilling fluids in accordance with State, Federal and local regulations.

1006.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only and the most recent edition shall be used.

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 13A

Specifications for Drilling Fluid -
Specification and Testing

1006.3 MATERIALS.

1006.3.1 Casing. Encasement pipe shall be smooth wall steel pipe. Steel casing pipe connections shall be achieved by joining beveled ends with a single V-groove by means of a full penetration butt joint welding, or an integral machine press-fit connection (Permalok or equal). Circumferential welds at casing joints shall contain sufficient passes (thoroughly cleaned between passes) to fill each joint flush with the outside diameter. The welding must be performed by a certified welder. Joint alignment shall be accurately maintained to prevent unacceptable joint deflection within the casing during progressive installation. The Contractor has the option of furnishing the casing pipe with a coating inside and out, or of supplying an approved thicker walled pipe with a sacrificial allowance. Unless noted otherwise, coating and lining shall be epoxy-polyamide system, applied in two coats and being at least eight (8) mils thick on each side.

Welded steel pipe shall have a minimum wall thickness as shown on the plans. In the event that jointing is necessary, welds shall be prepared for receiving the above specified coating by field application. Casing pipe shall first be sized per the plans. Provide at least one inch (1") circumferential clearance from the largest diameter element of the carrier pipe.

1006.3.2 Grout. Grout shall be Portland Cement Concrete (PCC) or Bentonite. The PCC shall be a mixture of Portland cement, sand and water and shall be of a fluid consistency that allows it to be pumped into the annular space between the casing pipe and the bore hole. PCC shall have a minimum compressive strength of 3000 psi. Bentonite shall conform with API Specification 13A and have the capacity of mixing with water to form a stable and homogeneous suspension. For annular spaces with less than two (2") inches clearance in any direction, the grout proportioned by volume shall be one (1) part Portland cement and two quarters to three (2-1/4 to 3) parts sand to which one tenths (1/10) part lime shall be added. For annular spaces two (2") inches or greater in any direction, the grout shall be one (1) part Portland cement, two to three (2 to 3) parts sand and not more than two (2) parts No. 4 concrete aggregate. Water volume shall be just sufficient to obtain a fluid consistency that allows the grout mixture to be pumped into the

annular spaces. Grouting shall be accomplished promptly after pipe installation has been completed to prevent any surface settlement due to movement of soil material into the void space or loosened zone around the pipe casing.

Minimum Wall Thickness Requirements for Steel Casing Pipe (In Inches)

Yield Strength of Casing Pipe	4	4.5	5.5625	6.625	8.625	10.75	12.75	14	16	18
35,000 psi Grade B	0.1	0.1	0.125	0.109	0.156	0.156	0.188	0.19	0.219	0.25
42,000 psi	0.1	0.1	0.125	0.109	0.125	0.156	0.172	0.19	0.203	0.25
52,000 psi	0.1	0.1	0.083	0.08	0.125	0.156	0.172	0.19	0.188	0.22
56,000 psi	0.1	0.1	0.083	0.08	0.125	0.156	0.172	0.19	0.188	0.22
60,000 psi	0.1	0.1	0.083	0.08	0.125	0.156	0.172	0.19	0.188	0.19
65,000 psi	0.1	0.1	0.125	0.08	0.156	0.172	0.188	0.19	0.188	0.19

Minimum Wall Thickness Requirements for Steel Casing Pipe (In Inches) Continued

Yield Strength of Casing Pipe	20	22	24	26	28	30	32	34	36
35,000 psi Grade B	0.28	0.312	0.344	0.375	0.41	0.44	0.438	0.469	0.5
42,000 psi	0.25	0.281	0.312	0.344	0.38	0.38	0.406	0.438	0.47
52,000 psi	0.25	0.25	0.281	0.312	0.34	0.34	0.375	0.406	0.41
56,000 psi	0.22	0.25	0.281	0.281	0.31	0.34	0.375	0.375	0.41
60,000 psi	0.22	0.25	0.25	0.281	0.31	0.31	0.375	0.375	0.38
65,000 psi	0.22	0.219	0.25	0.281	0.28	0.31	0.344	0.344	0.38

1006.3.3 Casing Insulators Typical Detail. Casing insulator bands shall be 8-inches wide for carrier pipe with diameters ranging from four to fourteen (4" to 14") inches, and twelve (12") inches wide for carrier pipe diameters sixteen to thirty (16" to 30") inches. Heavy duty stainless steel casing insulators 14 gauge (.074") steel, hot rolled and pickled, with deep embossed flanges shall be used for carrier pipe sizes ranging from six to thirty (6" to 36") inches. For carrier pipe sizes forty-two (42") inches and above, 12 gauge (.105") steel casing insulators are required.

Insulator selection and sizes shall be based on; the relative diameters of the carrier and casing pipes, the casing weight, and the manufacturer's specifications. Insulators with runners should be securely fastened to the outside of the carrier pipe while maintaining a minimum one (1") inch clearance to prevent it from resting or sliding on its joints during installation.

1006.3.4 Runners. Runners shall be two (2") inches minimum glass reinforced plastic or an Ultra high molecular weight polymer. The number and size of runners required is dependent upon the pipe size, the manufacturer's recommendations and the particular type of pipe being installed.

1006.3.5 Casing End Seals. Casing end seals shall be made of minimum one-eighths (1/8") inch thick specially compounded synthetic rubber for long life and easy installation. Either the pull on or wrap around type casing end seal shall be accepted after approval by the Engineer.

1006.3.5.1 Closing Encasement Pipe. After carrier pipe has been installed in the encasement pipe and after it has passed the quality and video camera alignment check, the ends shall be closed first with 6" of mortar and then with manufactured casing end seals (see STANDARD PLAN 3000-3).

1006.4 CONSTRUCTION REQUIREMENTS. The Contractor shall take the proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation needed to install the casing or carrier pipe. Any damage to surface or subsurface structures shall be repaired or replaced at the Contractor's expense. The Contractor shall swab and clean the bore hole before inserting in the casing or carrier pipe, preferably from the low or downstream end. Once casing is installed, the Contractor shall verify proper alignment per Section 2300.4.5, before installing the carrier pipe.

Gravity sewer casing or carrier pipe not meeting line and grade requirements is unacceptable and must be replaced at contractor's expense. Unless otherwise shown or specified on the contract drawings, the casing or carrier pipe shall not deviate more than +/- three (3") inches off grade and one foot off horizontal alignment. Displacement of casing or carrier pipe extremities by force, to get it on line and grade, is not allowed and shall be rejected.

If the casing pipe is installed slightly off grade and the Contractor can adjust the carrier pipe and/or its supporting insulators within the casing to get the carrier pipe back to the required grade, then the bored or jacked casing pipe may be acceptable. If in the judgment of the Engineer, the pipe is too far off grade or alignment to be unusable, the casing must be removed and reinstalled, or abandoned and another casing placed as required, at no additional cost to the City. Unless otherwise approved by the Engineer, the Contractor is not to proceed with installing the carrier pipe in the casing until the casing itself has been video inspected and checked for being installed on line and grade. It is important to note that acceptance of the casing does not imply, nor does it guarantee, acceptance of the carrier pipe. The carrier pipe will only be accepted after it has been video inspected and found to be installed on line and grade within the casing and that it doesn't have any sag in it.

A casing pipe of larger diameter than shown on the plans may be used, if the Contractor desires, but at no additional cost to the City and upon Engineer's approval. Upon acceptance of the casing, the Contractor shall install the carrier pipe in it, along with associated insulators and runners as applicable. The carrier pipe shall be videoed to check for cleanliness, quality of installation and alignment per the paragraph above and per Section 2300.4.5.

1006.5 CONTINGENCY SITUATIONS. If at any time the Contractor encounters an obstruction, during the boring or jacking operation that keeps him from maintaining line and grade, he is to attempt alternative measures that will overcome the obstruction or otherwise aid in determining the extent and nature of it. Such measures may include probing with a pilot bore, equipped with a directional head that is guided to probe the range of the object. Also, the Contractor might probe from the opposite direction by relocating the boring rig to the opposite embankment. In any event, the Contractor shall make a good faith effort for at least one work day to overcome the obstruction.

Should these efforts fail; the Engineer will assess the situation and make a determination as to whether or not a "Conditional Changed Work Condition" exists. Otherwise, it is to be concluded that the Contractor's bore or jack is off alignment and the City shall not be responsible and shall not issue a "Changed Work Condition" or authorize extra pay. Should there be a question or doubt about the obstruction being in the

path of the casing pipe to be laid, then a "Conditional Changed Work Condition" will be issued. In this case, the City will require proof or evidence of the obstruction as a condition to extra pay.

The Contractor must excavate up to the obstruction and maintain it in place, until the Engineer can inspect it. If the obstruction turns out to be a manmade obstruction or a rock greater than 4 inches in any dimension, then the "Conditional Changed Work Condition" shall be approved and paid. However, if only native soil, loam, sand, clay (hard or soft), silt, pea gravel or rocks less than 4 inches in dimension and not anticipated in a Geotechnical Report, then the "Conditional Changed Work Condition" shall not be approved, or paid. If the obstruction exists, the Engineer will determine if its removal will have a deleterious effect on the roadway, railway, etc. once approval is given, the Contractor can then remove and present the obstructive object to the Engineer as evidence to validate his claim for a "Changed Work Condition". If the object was manmade or was a rock four (4") inches or greater in any dimension and not anticipated in the geotechnical report then the "Changed Work Condition" shall be approved and paid.

1006.6 RAILROAD AND HIGHWAY CROSSINGS. The Louisiana Department of Transportation and Development (LADOTD) and the railroads both require piping to be encased when it passes under their rights-of-way. Where encasement or carrier pipe is to be installed under railroad embankments or under highways, streets, or other facilities, installation shall meet all requirements of the specific railroad company, the LADOTD, the local governing authority having jurisdiction over the installation, and these specifications. The Contractor shall obtain a copy of all required crossing permits prior to commencing the trenchless operation. The Contractor shall acquire notification period from permitting agency and provide notification within stipulated time frame to the permitting agency and the Engineer before initiating the installation. Construction activities must not interfere (i.e. delay, prohibit, or disturb) with the operation of the railroad, highway, or other facility, and will not weaken or damage any embankment or structure. Settlement shall comply with standards of permitting authority and be limited as stated in the permit. Any such damage shall be repaired at the Contractor's expense. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, per the governing regulations, until such time as the backfill has been completed and then shall be removed from the site.

1006.7 DRY AUGERING. Dry augering includes installing a casing while excavating the soil at the heading and transporting the spoil back through the casing by an otherwise uncased auger, and subsequent installation of a carrier pipe. The Contractor is required to continuously check and verify the alignment and grade of the casing during boring and jacking operations for gravity sewer lines. If the casing is off grade and alignment the Contractor must adjust the direction until he gets it to the required line and grade.

1006.7.1 Jacking. During jacking operations, the casing pipe is concurrently jacked into position. If the grade of the pipe, at the jacking end, is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the boring and jacking operations and for placing end joints on the pipe. This excavation is limited to the depth required for placing of the guide and jacking timbers and no nearer the roadbed than the minimum distance shown on the plans. On the opposite embankment, at the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in order to prevent caving or sliding of the walls into the open trench or pit (See Trench Safety Systems, Section 1004).

Heavy duty jacks, suitable for forcing the pipe through the embankment, shall be provided. Even pressure shall be applied to all jacks during the jacking operation. The jacking head shall be at least two (2") inches larger than the outside diameter of the pipe and consist of either steel or concrete construction. The jacking ring shall allow the jacking pressure to uniformly apply to the perimeter of the pipe. The jacking head shall be of such weight and dimensions that it will not bend or deflect when full pressure is applied to it. The jacking head shall be equipped with an opening for the removal of excavated material as the jacking proceeds. A suitable jacking frame or backstop, usually of timber, and suitable bracing between jacks and jacking head shall be provided.

The pipe support guides shall be straight and securely braced so that they securely support the pipe and

maintain it on the proper line and grade during the jacking operation. All timber and other materials used in the jacking assembly will be of good quality and dimensions since they must withstand all jacking stresses, while at the same time assuring even pressures are applied on the pipe during jacking operations. The whole jacking assembly shall be placed and aligned to assure that line and grade of the pipe are maintained. Maintain an envelope of bentonite slurry around the exterior of the pipe during the jacking operation to reduce the exterior friction and possibility of the pipe seizing in place. Unstable soil conditions and the length or size of the jacking operation may determine the installation of a concrete foundation to support and secure the entire jacking assembly to ensure designed line grade. The embankment soil shall be excavated slightly in advance of the jacked casing pipe. The Contractor is to avoid making the excavation larger than the outside diameter of the pipe. The excavated material is to be removed through the pipe.

Grouting of the annular space will not be required, if the void does not extend more than one (1") inch total beyond the outside diameter of the jacked pipe. If unsuitable soil conditions are found in the jacking pit, the Engineer may require that the carrier pipe installed by jacking be supported by quarter point cradle of 2,000 psi concrete across the jacking pit and to the first joint in the ditch section of each end, (see Section 201 for Concrete Requirements).

The distance that the receiving pit excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two (2') feet in any case. The pipe, preferably, shall be jacked from the low or downstream end. Lateral and vertical variations in the final position of the pipe from the line and grade established by the plans are detailed in Section 2300.4.5. The Contractor must maintain the final grade of the flow line in the direction indicated on the plans.

Once the jacking operation has been started, it shall continue without interruption, insofar as practicable; to prevent the pipe from seizing and binding in place before jacking is completed. Should the Engineer permit interruption of jacking operation, the Contractor shall provide bulkheads and dewatering measures as approved by the Engineer. Each pipe casing section shall be jacked forward as the excavation progresses in such a way to provide complete and adequate ground support at all times. When the jacking operation is complete, the Contractor shall verify the casing pipe for proper alignment, as detailed in Section 2300.4.5. Any pipe damaged in jacking operations shall be removed, repaired, and/or replaced at Contractor's expense.

Jack pits or trenches shall not be filled until casing and carrier pipes have been accepted as being on line and grade and all associated items have been installed, (carrier pipe, manholes, etc.). The Contractor shall not use force to displace the casing pipe ends in an effort to put them on line and grade. Use of such forced alignment methods is not acceptable. Pits and trenches are to be backfilled in accordance with Section 1002.

1006.7.2 Boring. The Contractor is to use a suitable boring rig to mechanically bore a smooth, straight shaft to the established line and grade shown on the plans. The bore hole diameter should be not more than two inches greater than the outside diameter of the pipebell. The casing pipe is pushed into the bored hole after the boring operation has been completed. Boring under paved streets shall be a minimum of five (5) feet under the top of curb or four (4) feet under the roadway base. Boring pits shall be shored, as required, with sheeting or other materials that are to be driven sufficiently below the carrier pipe invert to resist sloughing pressures of the surrounding soil.

If unsuitable soil conditions exist in the boring pit, the Engineer may require that the carrier pipe be supported by quarter point cradle of 2,000 psi concrete across the boring pit and to the first joint in the ditch section on each end (see Section 201 for Concrete Requirements).

The annular space between the bored hole and the pipe shall be filled with a grouting mixture of sand-cement meeting requirements of this section. The mixture should be of a consistency that allows a steady uniform delivery. Care shall be taken to grout in a continuous, uninterrupted operation so no distortion or flotation will occur to the carrier pipe. Alternative methods and materials for filling this annular space will be considered, subject to prior review and approval by the Engineer.

Grouting of the annular space will not be required if the diameter of the bored hole does not exceed the outside diameter of the pipebell by more than two (2") inches. Grouting shall be applied under controlled pressure using a direct-action pressure pump that delivers grout at a uniformly steady rate. Refer to piping section of contract plans for maximum pressure to avoid damage to pipe. The Contractor shall fill all voids completely without collapsing carrier pipe or damaging adjacent property. Grouting in general shall proceed from end to end with a continuous delivery. Grouting will be considered complete when no more can be forced into the void. Regrout of voids may be required, if considered necessary by the Engineer. The Contractor shall submit for approval the proposed method of grouting prior to use.

Where wet boring techniques are allowed, bentonite or other stabilizing gels shall be used to prevent caving of the unsupported bore hole. No wet bores shall be permitted for gravity sewer mains longer than fifty (50') linear feet, unless a "check pit" is dug if feasible at fifty (50') foot intervals, so that line and grade can be checked and unless the Contractor receives prior approval from the Engineer. In these cases, jacking with casing shall be permitted. The pipe within the boring shall be installed to the exact lines and grades required. In addition to the requirements stated above, the applicable provisions for "Jacking," in regard to the construction of trenches, tolerance in line and grade, method of operation, backfilling, etc., shall govern for construction by boring.

1006.8 SLURRY AUGERING. Slurry augering refers to installing a pipe with the use of a drilling fluid to facilitate in the drilling and soil removal process. Slurry augering is also referred to as "wet boring" or "fluid assisted mechanical drilling". Slurry augering will not be permitted without prior approval of the Engineer. Slurry augering will not be permitted for gravity sewer mains longer than fifty (50') feet unless "check pits" are dug at fifty (50') foot intervals, so that line and grade can be checked. The Contractor is required to drill a two (2") inch pilot hole for all slurry augering operations. The pilot hole shall serve as the centerline of the larger diameter hole to be bored. Unless otherwise shown or specified on the contract drawings, the pilot hole shall not deviate more than +/- six (6") inches off grade and one (1') foot off horizontal alignment. The Contractor is required to check and verify the alignment and grade of the pilot hole against the plans before continuing with boring operations for gravity sewer lines. If the pilot hole is off grade and alignment the Contractor must re-bore the pilot hole until he gets it to the required line and grade. Under no circumstances is the Contractor to proceed to the next step of the boring operations for gravity sewer lines without approval of the Engineer.

The use of water and other fluids in connection with the slurry augering operation will be permitted only to the extent necessary to maintain the excavation and lubricate the cuttings. Jetting will not be permitted. In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least ten (10 %) percent of high grade carefully processed bentonite, may be used to consolidate cuttings of the bit, to seal the walls of the hole, and to furnish lubrication for subsequent removal of cuttings and installation of the pipe thereafter. Over cutting in excess of 1 inch (25.4 mm) shall be remedied by pressure grouting the entire length of the installation.

1006.8.1 Excavations. If the grade of the pipe is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the augering and pullback operations and for placing end joints on the pipe. This excavation is limited to the depth required for placing of the equipment and no nearer the roadbed than the minimum distance shown on the plans. On the opposite embankment, at the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in order to prevent caving or sliding of the walls into the open trench or pit (See Trench Safety Systems, Section 1004).

Maintain an envelope of bentonite slurry around the exterior of the pipe during the pullback operation to reduce the exterior friction and possibility of the pipe seizing in place. The Contractor is to avoid making the excavation larger than the outside diameter of the pipe.

The distance that the receiving pit excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two (2') feet in any case. The pipe, preferably, shall be pulled from the low or downstream end. Lateral and vertical variations in the final position of the pipe from the line and grade established by the plans are detailed in Section 2300.4.5. The Contractor must maintain

the final grade of the flow line in the direction indicated on the plans.

When the pullback operation is complete, the Contractor shall verify the casing or carrier pipe for proper alignment, as detailed in Section 2300.4.5. Any pipe damaged in pullback operations shall be removed, repaired, and/or replaced at Contractor's expense.

Receiving pits or trenches shall not be filled until casing and/or carrier pipes have been accepted as being on line and grade and all associated items have been installed, (carrier pipe, manholes, etc.). Pits and trenches are to be backfilled in accordance with Section 1002.

1006.9 TUNNELING. Tunneling includes hand mining with a jacked casing or tunnel lining and bracing. Tunneling will be permitted at locations indicated on the plans or where specifically authorized in writing by the Engineer. Prior to submitting a proposal for tunnel work, the Contractor shall satisfy himself as to soil conditions and geological formation through which the tunnel is to be installed. Shaft locations and details of construction shall be where shown or detailed on the plans or where approved by the Engineer on shop or working drawings submitted by the Contractor.

Jacked casing shall meet the same requirements specified for dry augering. Tunnel lining and bracing of approved design shall be used in making and holding the tunnel excavation, and shall be placed immediately as the tunnel excavation work proceeds. Timber lagging and steel rings, or steel liner plates reinforced with ribs or rings shall be used as necessary to safely support the loads likely to be imposed.

1006.9.1 Grouting and Sealing. Voids between the tunnel lining and the surrounding earth shall be filled by grouting. Grouting shall be subject to the direction of the Engineer and shall follow immediately after completion of excavation and lining operations, as soon as practicable, in order to fill the voids outside of the lining before after-settlement may begin, and to stop the entrance of water into a tunnel through the lining at any point. Grouting shall be done by a suitable machine capable of forcing grout into all of the voids which may have been left behind the tunnel lining or in the adjacent earth which may have been disturbed by tunnel operations. A maximum pressure of 50 psi at the grouting nipple may be required.

1006.9.2 Jacking. Jacking shall be per subsection 1006.7.1 of this specification.

1006.10 MEASUREMENT AND BASIS OF PAYMENT.

1006.10.1 Pilot & Check Holes. The drilling of pilot and check holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the bid proposal and contract.

1006.10.2 Dry Augering with Casing and Carrier Pipe. Payment for dry augering is based on the diameter and linear foot of the installed casing pipe. Measurement shall be along the centerline of the casing pipe. Payment includes the cost of the installed carrier pipe, the bore pit, receiving pit and annular grouting regardless of depth. Payment of the contract bid amount shall be full compensation for furnishing all labor, materials, equipment and incidentals, required to complete the dry augering operation with casing and carrier pipe as specified and shown on the drawings. No additional compensation will be paid for tunneling, excavation, sheeting and shoring, dewatering, backfill, compaction, grouting, restoration, testing, and other necessary operations.

1006.10.3 Slurry Augering with Casing and Carrier Pipe. Payment for slurry augering with casing and carrier pipe is based on the diameter and linear foot of the installed casing pipe. Measurement shall be along the centerline of the casing pipe. Payment includes the cost of the installed carrier pipe, the entrance pit, exit pit and annular grouting regardless of depth. Payment of the contract bid amount shall be full compensation for furnishing all labor, materials, equipment and incidentals, required to complete the slurry augering operation with casing and carrier pipe as specified and shown on the drawings. No additional compensation will be paid for tunneling, excavation, sheeting and shoring, dewatering, backfill, compaction, grouting, restoration, testing, and other necessary operations.

1006.10.4 Slurry Augering Carrier Pipe without Casing. Payment for slurry augering carrier pipe is based on diameter and linear foot of the installed carrier pipe from the face of the entrance pit to the face of the exit pit. Payment includes the cost of the installed carrier pipe, the entrance pit, exit pit, and annular grouting regardless of depth. Payment of the contract bid amount shall be full compensation for furnishing all labor, materials, equipment and incidentals, required to complete the slurry augering operation with carrier pipe as specified and shown on the drawings. No additional compensation will be paid for tunneling, excavation, sheeting and shoring, dewatering, backfill, compaction, grouting, restoration, testing, and other necessary operations.

1006.10.5 Tunneling with Carrier Pipe. Payment for tunneling with carrier pipe is based on the diameter and linear foot of the installed carrier pipe. Measurement shall be along the centerline of the casing pipe or along the centerline of the tunnel from face of the entrance pit to the face of the exit pit. Payment includes the cost of the installed carrier pipe, the entrance pit, exit pit and annular grouting regardless of depth. Payment of the contract bid amount shall be full compensation for furnishing all labor, materials, equipment and incidentals, required to complete the slurry augering operation with casing and carrier pipe as specified and shown on the drawings. No additional compensation will be paid for tunneling, excavation, sheeting and shoring, dewatering, backfill, compaction, grouting, restoration, testing, and other necessary operations.

1006.10.6 Tunneling. The unit price for tunneling set forth in the proposal shall include full compensation for all labor and materials for constructing tunnel and carrier pipe complete in place as indicated.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1006(1)	Dry Augering with Casing and Carrier Pipe (Casing Diameter)	Linear Foot (LF)
1006(2)	Slurry Augering with Casing and Carrier Pipe (Casing Diameter)	Linear Foot (LF)
1006(3)	Slurry Augering Carrier Pipe without Casing (Carrier Pipe Diameter)	Linear Foot (LF)
1006(4)	Tunneling (all types) with Carrier Pipe	Linear Foot (LF)

PART II

SECTION 1101

PAINTING

1101.1 GENERAL

1101.1.1 Weather Conditions. Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided herein, painting will not be permitted when weather conditions are such that the atmospheric temperature is at or below 35 degrees F, (1 deg. C), or when freshly painted surfaces may become damaged by rain, fog, or condensation or when it can be anticipated that the atmospheric temperature will drop below 35 degrees F (1 deg. C) during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the contractor at his expense.

Subject to the approval of the Engineer, the contractor may provide suitable enclosures to permit painting during inclement weather. Provisions must be made to artificially control atmospheric conditions within limits suitable for painting inside the enclosure throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

1101.1.2 Application. Painting shall be done in a neat and workmanlike manner. Unless otherwise specified, paint shall be applied by brush, roller, or spray methods. If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. The paint will be considered to have improperly applied if an inordinate amount of residual brush marks remain. If rollers are used, they shall be of a type that do not leave a strippled texture in the paint film.

On all surfaces which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer. If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory, and the contractor may be required to apply the remainder of the paint by brush. A water trap acceptable to the Engineer shall be furnished and installed on all equipment used in spray painting. Mechanical mixers shall be used to mix the paint a sufficient length of time prior to use to thoroughly mix the pigment and vehicle. To keep the pigment in suspension, paint shall be kept thoroughly mixed while being applied.

1101.1.3 Thinning Paint. Paints specified are formulated ready for application and no thinning will be permitted. If the paint becomes thick in cool weather, it shall be heated by immersing the container in hot water.

1101.1.4 Protection of Work. The contractor shall protect all parts of the structure against disfigurement as a result of its painting operations. The contractor shall be responsible for any damage caused by its operations to vehicles, persons, or property, and shall provide at its expense protective means to guard against such damage. Paint stains on adjacent improvements which result in an unsightly appearance shall be removed by the contractor at its expense.

1101.2 SURFACE PREPARATION FOR STEEL.

1101.2.1 General. Metal surfaces to be painted shall be cleaned by one of the following methods in accordance with standard specifications of the Steel Structures Painting Council preparation specifications: Hand cleaning, solvent cleaning, power tool cleaning, and blast cleaning. Unless otherwise specified in the project specifications or required by the Engineer, blast cleaning method shall be used for steel for bridges and drainage structures; steel for buildings shall be wire brushed or power tool cleaned.

1101.2.2 Blast Cleaning. Blast cleaning is a method of preparing metal surfaces for painting by removing mill scale, rust, rust scale, paint or foreign matter by the use of abrasives propelled through nozzles or by centrifugal wheels, to obtain the following degree of surface cleanliness.

1101.2.2.1 Near-White. A near-white blast cleaned surface finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks, or slight discolorations caused by rust stain mill scale oxides, or slight, tight residues of paint or coating that may remain. At least 95 percent of each square inch (.00065 m²) of surface area shall be free of all visible residues. The remainder shall be limited to light discoloration mentioned above.

1101.2.2.2 Methods of Blasting. The surface of the metal may be blast cleaned by any one of the following methods in accordance with SSPC-SP-10, dry sandblasting, wet sandblasting, grit, shot. The blast-cleaned surface shall be primed, as specified, within 8 hours after blasting when practicable, but in any event not later than 24 hours after blasting and also before any visible or detrimental rusting occurs. Surfaces which rust before painting is accomplished shall be re-cleaned by the contractor at his expense.

1101.3 SURFACE PREPARATION FOR PAINTING GALVANIZED SURFACES.

1101.3.2 Solvent Cleaning. After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed in Subsection 1101.2.2 herein to remove oil, grease, and other detrimental foreign matter.

1101.4 SURFACE PREPARATION FOR PAINTING WOOD SURFACES. Wood surfaces shall be prepared for painting by removing all cracked or peeled paint, loose chalky paint, dirt, and other foreign matter by wire brushing, scraping, sanding or other approved means immediately prior to painting. All surfaces shall be wiped or dry brushed to remove any dust or chalky residue that may result from cleaning operations. All wood designated to be painted shall be thoroughly dry before paint is applied.

1101.5 PAINTING STRUCTURAL STEEL. Unless otherwise required on the plans or in the project specifications, the paints to be applied to structural steel surfaces shall consist of 3 mils prime coat. Intermediate coats shall be not less than 3 mils (0.076 mm), and the total dry film thickness of the two finish coats shall be not less than 2 mils (0.05 mm). The dry film thickness of the paint will be measured in place with a calibrated magnetic film thickness gage. Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Painting of structural steel, except for shop-applied prime coats and sections which will be inaccessible after erection as described herein, shall be done after erection unless otherwise specified. Requests to do any additional painting prior to erection shall be submitted by the contractor and approved by the Engineer in writing before such work is started.

In any case, the amount of painting done prior to erection will be limited to a prime coat of paint. Any deficiencies in the first coat of paint shall be corrected prior to the application of succeeding coats of paint.

1101.6 PAINING GALVANIZED SURFACES. Unless otherwise specified, galvanized surfaces shall be left unpainted. When required to be painted, the surface shall be prepared as specified in Subsection 1101.3 and then painted with three coats of paint of the type specified for galvanized metal surfaces in Subsection 210.5 hereof. Full compensation for painting such surfaces shall be included in the price paid for the various contract items involving galvanized metal objects and no separate payment for such painting will be made.

1101.7 PAINING LUMBER. The paint and number of coats to be used will be as prescribed in Subsection 210.3 for wood structures, or as specified by the Engineer. On all lumber previously painted, the number of coats and types of paint will be specified in the project specifications. When permitted by the Engineer, the first coat of paint may be applied prior to erection. After the first coat has dried and the lumber is in place, all cracks, checks, nail holes, etc., shall be puttied flush with the surface and allowed to dry before the second coat is applied. Skips, thin areas or other deficiencies in any one coat of paint shall be corrected before the succeeding coat is applied.

1101.8 PAYMENT. Full compensation for preparing surfaces and for painting shall be considered as included in the prices for the various contract items of work and no separate payment for such work will be made.

PART 12

MISCELLANEOUS CONSTRUCTION

SECTION 1201

LANDSCAPING AND SEEDING

1201 REMOVAL OF EXISTING SOD. Where construction required the permanent removal of sod on residential lots, the contractor is required to leave the removed sod with the homeowner if he homeowner so desires.

1201.1 DESCRIPTION. This work consists of performing required preparatory work, furnishing and installation of lawn and plant materials in accordance with the drawings, these specifications. Refer to Section 203 for soil and grass materials. Provide trees, plants, ground covers, and accessories, as shown and specified. The work includes:

1. Soil preparation
2. Trees, plants, and ground covers
3. Planting mixes
4. Mulch and planting accessories
5. Existing tree care
6. Tree relocation
7. Maintenance

1201.1.2 Quality Assurance.

- A. Plant names indicated comply with "Standardize Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged. No substitutions will be allowed unless approved in writing by Project manager.
- B. Comply with sizing and grading standards of the latest edition of "American Standard for Nursery Stock." A plant shall be dimensioned as it stands in its natural position.
- C. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project for a minimum of one year.
- D. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to size indicated. Where a minimum and maximum size (size range) is specified, the average of the lot will approximate the midpoint of the specified size range and 50% of the lot will be within the middle 1/3 of the specified range. Where a caliper and height range are given the minimum of each range shall be the minimum acceptable.
- E. Where called for, provided "specimen" plants with a special height, shape, or character of growth. Tag specimen trees or shrubs at the source of supply. The project manager will inspect specimen selections at the local sources of supply for suitability and adaptability to selected location. When specimen plants cannot be purchased locally,

provide sufficient photographs of the proposed specimen plants for approval.

- F. Plants may be inspected and approved at the place of growth for compliance with specifications requirements for quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.

I201.1.3 Submittals.

- A. Submit the following material samples:
 - 1. Mulch
 - 2. Decomposed Pine Bark Soil Conditioner
- B. Submit the following materials certification:
 - 1. Topsoil source and Ph value
 - 2. Plant fertilizer
 - 3. Pre-emergent herbicide
- C. Upon plant material acceptance, submit written maintenance instructions recommending procedures for maintenance of plant materials.

I201.1.4 Deliver, Storage, and Handling.

- A. Deliver fertilizer and herbicide materials in original, unopened, and undamaged containers showing weight, analysis, and name of manufacturer. Store in manner to prevent wetting and deterioration.
- B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. This should include spraying deciduous plants in foliage with an approved "Anti-Desiccant" immediately after digging when necessary to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order to stock and on arrival, the certificate shall be filed with Project manager. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet bark mulch, or in a manner acceptable to the project manager. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.
- C. Cover plants transported on open vehicles with a protective covering to prevent wind burn.
- D. Provide dry, loose topsoil for planting bed mixes. Frozen or muddy topsoil is not acceptable.

I201.1.5 Project Conditions.

- A. Notify project manager at least 5 working days prior to installation of plant material.
- B. Protect existing utilities, paving, and other facilities from damage caused by planting operations.
- C. A list of plants, including a schedule of sizes, quantities, and other requirements is shown on the drawings. In the event that quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall

govern.

- D. If an irrigation system will be installed prior to planting, locate, protect, and maintain the irrigation system during planting operations. Repair irrigation system components, damaged during planting operations, at this contractor's expense.

1201.1.6 Warranty.

- A. Warrant plant material to remain alive and be in healthy, vigorous condition for a period of one year after completion and acceptance of the entire project or for the warranty period required in the general conditions, whichever is longer.
- B. During the warranty period, replace, in accordance with the drawings and specifications, all plants that are dead or, as determined by the project manager, are in an unhealthy or unsightly condition, and have lost their natural shape due to dead branches, or other causes not due to the owner's negligence. The cost of such replacement(s) is at Contractor's expense. Warrant all replacement plants for one year after installation.
- C. Warranty shall not include damage or loss of trees, plants, or ground covers caused by fires, floods, freezing rains, lightning storms, or winds over 75 miles per hour, winter kill caused by extreme cold and severe winter conditions not typical of planting area, acts of vandalism or negligence on the part of the Owner.
- D. Remove and immediately replace all plants, as determined by the project manager, to be unsatisfactory during the initial planting installation.

1201.1.7 Materials.

- A. Plants: Provide plants typical of their species or variety with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sun scald injuries, frost cracks, abrasions of the bark, plant diseases, weeds, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage. Deciduous shade trees shall be straight and symmetrical with a crown having a persistent main leader unless otherwise specified. The size of the crown shall be in good overall proportion to the total height of the tree. Evergreen trees shall be of form typical of the species and not unnaturally sheared or color treated.
 - 1. Dig balled and burlapped plants with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Provide ball sizes complying with the latest edition of the "American Standard for Nursery Stock". Cracked or mushroomed balls are not acceptable.
 - 2. Container-grown stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.
 - a. No plants shall be loose in the container.
 - b. Container stock shall not be root nor pot bound.
 - 3. Unless otherwise called for, provide tree species with a single main trunk. Trees that have the main trunk forming a "Y" shape are not acceptable.
 - 4. Plants of one variety planted in rows shall be matched in form.

5. Plants larger than those specified in the plant list may be used when acceptable to the Project manager. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of the plant.
6. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size designated in the plant list.
7. No pruning wounds shall be present with a diameter of more than one inch, and such wounds must show vigorous bark on all edges.
8. Evergreen trees shall be branched to the ground.
9. Shrubs and small plants shall meet the requirements for spread and height indicated in the plant list.
 - a. The measurements for height shall be taken from the ground level to the average height of the top of the plant and not the longest branch.
 - b. Single stemmed or thin plants will not be accepted.
 - c. Side branches shall be generous, well-twiggged, and the plant as a whole well-bushed to the ground.
 - d. Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

1201.1.8 Accessories.

- A. Topsoil for Planting Bed: Fertile, friable, natural topsoil of loamy character, containing not less than 1-1/2 percent organic matter, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between Ph 6.5 and 7.0.

1. Identify source location of topsoil proposed for use on the project.
2. Provide topsoil free of substances harmful to the plants which will be grown in the soil.

Public Roads Administration Classification shall be A-4 or A-6 silt loam. Extractable quantities of phosphorous, potassium, and magnesium shall be 100 parts per million each (minimum). Minimum extractable quantity of calcium shall be 1000 parts per million. Method of testing shall be as performed by State Cooperative Extension Service.

- B. Soil Conditioner: One of the following:

1. Decomposed pine bark: Consisting of pure bark sawmill fines mixed with approximately 10% sand. Sawmill fines shall be 1/2 inch maximum size and shall have been compost a minimum of 2 years.
2. Peat Moss: Commercial Quality Michigan or Canadian. Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral content on a dry basis.

- C. Fertilizer:

1. Plant Fertilizer Type "A": Commercial type approved by the Project manager, containing 12% nitrogen, 12% phosphoric acid, and 12% potash by weight; 1/4 of nitrogen in the form of nitrates, 1/4 in form of ammonia salt, and 1/2 in form of organic nitrogen. Apply to planting beds at a rate of one pound per fifty square feet. D. Herbicide: "Eptam", "Treflan" or "Surflan" or other pre-emergent herbicide approved for use with the plants specified.

- D. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces, permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.
- E. Mulch: Premium grade shredded pine bark 3/4" to 2" diameter. Dry and free of pitch and excessive fines. Furnish in 3 cubic feet bags or bulk.
- F. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation furnished by Contractor.
- G. Stakes for guying and staking: Wolmanized pine, 2" x 2" x length shown in drawings.
- H. Guying/Staking Wire: No. 14 gage galvanized wire.
 - I. Turnbuckles: Galvanized steel of size and gage required to provide tensile strength equal to that of the wire. Turnbuckle openings shall be at least 3".
- I. Staking and Guying Hose: Two-ply, reinforced garden hose not less than 1/2" inside diameter.
- J. Jute Mat: Shall be "Ludlow Soil Saver" heavy jute mat as manufactured by Ludlow Corporation, 145 Rosemary Street, Needham Heights, MA 02194, or approved equal.
- K. Metal edging: Steel or Aluminum Alloy, Painted (green) 3/16" thick x 4" depth with interlocking joints and pins, minimum 15" length, 30" on center.
- L. Railroad Tie Bed Edgers: Used ties weathered so that excess creosote has leached out and will not injure plants. 8' long of solid pine with no rot or deterioration and free of old metal spikes, plates, nails, or other hardware.

1201.1.9 Inspection.

- A. Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

1201.1.10 Preparation.

- A. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor. All plant stock shall be handled with reasonable care to prevent injuries to trunk, branches, roots, and leaves.
- B. Locate plants as indicated or as approved in the field after staking by the Contractor. If obstructions are encountered that are not shown on the drawings, do not proceed with planting operations until alternate plant locations have been selected and approved by the project manager.
- C. Excavate circular plant pits with vertical sides, except for plants specifically indicated to be planted in beds. Provide shrub and tree pits at least twice the diameter of the root system. Depth of pit shall accommodate the root system plus 6". Scarify and compact the soil in the bottom of the pit.

- D. After the planting pit has been dug, distribute over the soil from the pit: Soil Conditioner (1/4 by volume of soil from the planting pit) and topsoil (1/4 by volume of soil from the plant pit). Mix these thoroughly and evenly with the soil from the pit to form the planting mixture.
- E. Remove all living vegetation from areas designated as planting beds and spade all bed areas to a depth of 12 ". Add 2" topsoil, 2" of soil conditioner, and fertilizer. Till bed areas to incorporate the mixture to a depth of 8 inches. Incorporate pre-emergent herbicide as recommended by the manufacturer.

1201.1.11 Installation.

- A. Set plant material in the planting pit to proper grade and alignment. Set plants upright, plumb, and faced to give the best appearance or relationship to each other or adjacent structure. Unless otherwise directed by the project manager, set plant so that when planted and settled it will bear the same relation to finished grade that it did to the soil surface in the original place of growth. No filling will be permitted around trunks or stems. Backfill the pit with planting mixture, firmly tamping to fill all voids. Do not use frozen or muddy mixtures for backfilling. Form a 3" high ring of soil around the edge of each planting pit to retain water.
- B. Space ground cover plants in accordance with indicated dimensions. Adjust spacing as necessary to evenly fill planting bed with indicated quantity of plants. Plant to within 12" of the trunks of trees and shrubs within planting bed and to within 6" of edge of bed. Set plants in neat, straight rows, parallel to the nearest paving edge or header at intervals shown in the drawings.
- C. Metal Edging: Anchor edging with minimum 3 pins/section.
- D. Railroad Tie Edging: Cut to proper length and angle and install in the locations shown in the drawing. Supply rebars and spike into place as shown in the drawing.
- E. Mulching: Mulch tree and shrub planting pits and shrub and ground cover beds with required mulching materials 2" deep immediately after planting. Thoroughly water mulched areas. After watering, rake mulch to provide a uniform finished surface.
- F. Guying and Staking:
 - 1. Stake/guy all trees immediately after lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may affect tree survival or appearance occur, the landscape may require immediate staking/guying.
 - 2. Stake trees under 3" caliper as shown in the drawings.
 - 3. Guy deciduous trees over 3" caliper as shown in the drawing.
 - 4. All work shall be acceptable to the project manager.
- G. Pruning:
 - 1. Prune branches of deciduous stock, after planting, to balance the loss of roots and preserve the natural character appropriate to the particular plant requirements. In general, remove 1/4 to 1/3 of the leaf bearing buds; proportion shall in all cases be acceptable to the project manager. Remove or cut back broken, damaged, and unsymmetrical growth of new wood. Make cuts flush with trunk or intersecting

- branch.
- 2. Multiple leader plants: Preserve the leaders which will best promote the symmetry of the plant. Cut branches flush with the trunk or main branch, at a point beyond a lateral shoot or bud a distance or not less than 1/2 the diameter of the supporting branch. Make cut on an angle.
- 3. Prune evergreens only to remove broken or damaged branches.

H. Care of Existing Trees:

- 1. Selectively prune existing trees in designated areas, under project manager's direction. Remove sucker shoots, dead, rubbing and damaged branching.

I. Tree Relocation and Mechanical Transplanting:

- 1. Prune, dig, ball and burlap, and move designated trees for relocation to the designated plant storage area for heeling-in of materials until final planting areas area prepared.
 - a. Maintain plants in storage areas by bracing plants in vertical position and setting balls in an enclosed berm of topsoil or bark. Water as required to maintain adequate root moisture.
 - b. Re-burlap plant's balls if required before final transplanting operations.
 - c. Move to final locations shown on the drawings and plant in accordance with specified tree planting requirements.
- 2. Where indicated on the plans, plants shall be mechanically dug and transplanted.
 - a. Equipment: All mechanically dug plants shall dug, transported, and re-set using a self-contained hydraulic tree spade complete with four spade blades, levelers, and watering tank.
 - b. The diameter of the tree spade shall be at least ten (10") inches for each one (1") of caliper of the plant to be transplanted, unless approved in writing by the project manager.
 - c. The receiving hole shall be prepared by firmly setting four (4) slow release fertilizer tablets (Agri-form or equal) into the sides of the hole, equidistant around the perimeter and 1' - 2' below the existing grade.
 - d. The top of the transplanted root ball shall be within two inches (2") of the surrounding grade. Contractor shall backfill, water and seal the crack between the rootball and the hole, adding sandy soil as required to fill all voids.
 - e. Form a 3" high ring of soil around the edge of each transplanted plant to retain water.
 - f. Mulch, prune, and maintain plants as specified elsewhere. Guying and staking shall be required unless high winds or other conditions which may effect tree survival or appearance occur.

I 201.1.12 Maintenance.

- A. Maintain planting until completion and acceptance of the entire project.
- B. Maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plants free of insects and disease.
 - 1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove dead material.
 - 2. Tighten and repair guy wires and stakes as required.
 - 3. Correct defective work as soon as possible after deficiencies become apparent and weather and season

permit.

4. Water trees, plants, and ground cover beds within the first 24 hours of initial planting. Irrigate all plants regularly in order to supplement natural rainfall to a total of 2" per week until final acceptance. Irrigation by hose or any other method shall not be applied with a force that will displace mulch or cause soil erosion and shall not be applied so quickly that it cannot be absorbed by the mulch and plants.
5. Replace mulch as needed.
6. In plant beds, grass and weeds shall not be allowed to reach a height of 3 inches before being completely removed, including the root growth. When plants are in groups other than cultivated beds, the Contractor shall not permit grass or other vegetation between them to become more than 5 inches in height.

1201.1.13 Acceptance.

- A. Planted areas will be inspected at completion of the project and accepted subject to compliance with specified materials and installation requirements.
- B. Upon acceptance, the owner will assume plant maintenance.

1201.1.14 Cleaning.

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from planting operations.

1201.2 TOPSOIL PREPARATION AND CONDITIONING.

1201.2.1 General. The thickness of topsoil shall be as shown on the plans, or if not shown, shall be 6 inches thick (152 mm). Planting areas shall be free of weeds and other extraneous materials to a depth of 12 inches (305 mm) below finish grade before topsoil work. Soil shall not be worked when it is so wet or so dry as to cause excessive compaction or the forming of hard clods or dust.

1201.2.2 Fertilizing and Conditioning Procedures. The planting area shall be brought to finish grade before spreading the fertilizers or conditioning materials specified. After spreading, the fertilizing and conditioning materials shall be uniformly cultivated into the upper 6 inches (152 mm) of soil by suitable equipment operated in at least two directions approximately at right angles. The resulting soil shall be in a friable condition.

1201.2.3 Agricultural Lime. When specified in project specifications, agricultural lime shall be spread uniformly over the area to be limed at the rate of 2 tons per acre (1.8 metric ton/.404 h) with a spreader. The lime must be applied prior to seeding and may be applied in conjunction with the fertilizer. Several passes may be required to obtain the desired application rate. Soon after application, the entire area shall be disked, harrowed, or rototilled to incorporate the lime or lime-fertilizer into the top 3 to 6 inches (76 to 152 mm) of the soil.

1201.3 FINISH GRADING. The finish grade shall be smooth, uniform, and free of abrupt grade changes and depressions to insure surface drainage. The finished grade below adjacent paving, curbs or headers shall be 1 inch (25 mm) in lawn areas and 2 inches (51 mm) in shrub or ground cover areas.

After fertilizing and conditioning, the soil shall be watered and allowed to settle to provide a stable surface, not overly

densified to the extent that it will present aeration and water infiltration. After the soil has dried out to a workable condition, the planting areas shall be regraded, raked, and smoothed to the required grades and contours. Finish surfaces shall be clean and suitable for planting.

1201.4 PLANTING.

1201.4.1 General. The types, sizes and quantities of plant materials shall be as called for in the contract document. All plants will be inspected prior to placing, including plants previously approved at the nursery. The contractor shall be responsible for the condition of all plants, planted or otherwise, until acceptance. Planting shall be performed with materials, equipment, and procedures favorable to the optimum growth of the plants and in compliance with these procedures.

1201.4.2 Protection and Storage. The contractor shall keep all plant material delivered to the site in a healthy condition for planting. Plants shall not be allowed to dry out. Bare root stock shall be separated and “heeled in” in moist earth or other suitable material. Balled and burlapped plants shall have the root ball covered with moist sawdust, wood chips, or other approved materials.

1201.4.3 Layout and Plant Location. Planting areas will be indicated on the drawings. Detailed layout within the planting areas shall be performed by the contractor and approved by the Engineer prior to planting. The first row of plants in areas designated for center to center spacing of plants shall be located at one-half of designated spacing from the edge of the area.

1201.4.4 Tree and Shrub Planting. Planting holes shall be approximately square with vertical sides twice the depth and width of the plant container or ball, and shall be larger if necessary to permit handling and planting without injury or breakage of the root ball or root system. Any plant with a broken or cracked root ball before or during planting shall not be planted.

Containers shall be opened and removed in such a manner that the plant root is not injured. Balled plant wrappings shall be loosened or cut back after plant is positioned in the planting hole. The native soil at the bottom of planting holes shall be scarified to a depth of 6 inches (152 mm).

After planting, the plant shall be plumb, with the root crown at its natural growing depth with respect to finish grade. Planting shall be governed by the following requirements:

1. A layer of prepared soil mix shall be deposited in the planting hole.
2. The plant shall be set approximately at the center of the hole.
3. Prepared soil mix shall be deposited in the remainder of the hole to finish grade.
4. The backfill shall be thoroughly water-settled and additional prepared soil mix added to fill any remaining void below finish grade.
5. A circular watering basin slightly larger than the planting hole, 4 inches (102 mm) high for trees and 2 inches (51 mm) high for shrubs, shall be left around the plant. The bottom of the basin shall be at approximate finish grade or slightly lower. Type 1, 2, 3, or 4 mulch shall be spread at least 2 inches (51 mm) thick in the basin.
6. The plant shall be guyed and staked.
7. The area around plants shall be regraded to finish grade. Excess soil shall be disposed of by the contractor.

1201.4.5 Ground Cover and Vine Planting. Soil preparation and fine grading shall be completed prior to ground cover planting. Ground cover and vines shall be planted in moist soil and spaced as indicated on the plans. Each plant shall be planted with its proportionate amount of flat soil to minimize foot disturbance. Soil moisture shall be such that the soil does not crumble when removing plants.

Following planting, ground cover and vine areas shall be regraded to restore smooth finish grade and to insure proper surface drainage. A 1-inch (25 mm) layer of specified mulch shall be spread over the planted areas. Watering shall begin immediately following mulching.

When necessary to prevent plant damage from pedestrian traffic during the initial growing stage, the contractor shall erect temporary protective fencing to be removed at the end of the plant establishment period.

Vines shall be tied to walls, fences, etc. in the manner prescribed on the plans. Temporary staking shall be removed at the end of the plant establishment period.

1201.5 LAWN PLANTING.

1201.5.1 General. Before planting lawn, all specified soil preparation and fine grading shall be completed.

1201.5.2 Seed Lawn Planting. Seed lawn planting may be accomplished by Method A (dry method) or Method B (hydraulic method). Seeding shall not be performed when the wind velocity exceeds 5 miles per hours (8km-hr), or is detrimental to the uniform distribution of the seed.

A. **Method A Seed Lawn Planting.** The area to be seeded shall be lightly raked to provide a seed bed. The required seed mixture shall be sown uniformly at the specified rate. Seeding shall be done on two operations with the spreader set to sow one-half the specified amount in each operation. The second sowing shall be at right angles to the first. After sowing, the area shall be evenly covered with an approved mulch.

The lawn area shall be watered in a manner so as not to cause surface erosion. Newly seeded surfaces shall be kept moist continuously throughout the germination period.

B. **Method B Seed Lawn Planting.** The seed, fertilizer, fiber and other materials in the slurry mixture shall be as specified. All materials shall be of such character that they will disperse into a uniform slurry when mixed with water. The mixture shall be such that an absorbent porous mat will be formed. All materials must be available for inspection prior to application. Weights and contents of containers shall be clearly identified. A green coloring additive shall be used in the slurry for visual inspection purposes.

The slurry shall be applied under pressure at the specified rates. Areas to be planted by this method shall be moistened to a depth of 6 inches (152 mm) but shall not be surface wet at the time of application. The slurry planted areas shall be kept moist during the germination period, but puddling shall be avoided.

1201.5.3 Sod Lawn Planting. The type and thickness of sod and the areas to be sodded shall be in accordance with the contract documents.

Subgrade for sod shall be the specified thickness of the sod below finish grades. Soil conditioning and fine grading shall be completed before sodding. No heavy equipment shall operate over the subgrade after grading is completed.

The subgrade shall be moist but not wet when sod is laid. Sod shall be laid with closely fitted joints, and the ends of the strips shall be staggered. Openings shall be plugged with sod or topsoil.

Within two hours after installing sod and before rolling, the sod shall be lightly irrigated. All seams and joints shall then be rolled until the sod is well bonded to the subgrade. The area shall then be watered thoroughly to penetrate the subsoil at least 8 inches. Watering shall be repeated as necessary to keep the sod moist until rooted into the subgrade. Sodded areas shall be protected against foot traffic until the sod is well established.

1201.6 MAINTENANCE AND PLANT ESTABLISHMENT. The contractor shall maintain all planted areas on continuous basis as they are completed during the progress of the work and during the establishment period, and shall continue to maintain them until final acceptance.

All planted areas shall be kept free of debris and shall be weeded and cultivated at intervals not to exceed 10 days. The first mowing of lawn areas shall be performed when the grass is 2½ inches (64 mm) high and shall be repeated as often as is necessary to maintain the lawn at a height of 2 inches (51 mm). In no case shall the lawn be cut lower than 1½ inches (38 mm) in height. Any required pruning of plants will be designated by the Engineer at the start of the plant establishment period, and the contractor shall perform the pruning as part of the plant establishment work.

The contractor shall request a final inspection to begin the plant establishment period after all planting and related work has been completed in accordance with the contract documents.

1201.7 METHOD OF MEASUREMENT.

- a. Topsoil furnished, placed and accepted will be measured by the square yard in place.
- b. Vegetative Mulch will be measured by the ton, complete in place and accepted. The weight for measurement will be the product of the number of bales used and the average weight per bale as determined on certified scales provided by the contractor. Emulsified asphalt placed and accepted will be measured by the gallon.
- c. Fertilizer furnished, applied and accepted will be measured by the pound.
- d. Agricultural Lime furnished, placed and accepted will be measured by the ton.
- e. Plants. Furnishing and planting of the various types and sizes of plant materials will be measured per each, complete in place and accepted.
- f. Lawn Planting. Method A (dry) will be measured by the pound of seed used in the completed and accepted seeding.
- g. Lawn Planting. Method B (hydraulic) will be measured by the square yard complete in place and accepted.
- h. Sod Lawn. The quantities of sodding for payment will be the design areas as indicated on the drawings.

1201.9 BASIS OF PAYMENT. The accepted quantities of lawnscape items will be paid for at the contract unit price as follows:

Item No.	Pay Item	Pay Unit
I201(1)	Top Soil	Square Yard
I201(2)	Vegetative Mulch	Ton
I201(3)	Fertilizer	Pound
I201(4)	Lime	Pound
I201(5)	Plants (Type, Size)	Each
I201(6)	Lawn Planting Seed (A)	Pound
I201(7)	Lawn Planting Seed (B)	Square Yard
I201(8)	Sod Lawn	Square Yard
I201(9)	Asphalt Material	Gallon

SECTION 1202

MOBILIZATION

1202.1 DESCRIPTION. This work consists of preparatory work and operations, including those necessary for movement of personnel, equipment, supplies and incidentals to the project site; the establishment of offices, buildings and other facilities necessary for work on the project; the cost of bonds and any required insurance; and other preconstruction expenses necessary for start of the work, excluding the cost of construction materials.

1202.2 BASIS OF PAYMENT.

- a. When the contract does not include a pay item for mobilization, no direct payment will be made for mobilization.
- b. When the contract contains a pay item for mobilization, payment will be made at the contract lump sum price, subject to the following provisions:

Partial payments for mobilization will be made in accordance with the following schedule up to a maximum of 10 percent of the original total contract amount, including this item, and payment of any remaining amount will be made upon completion of all work under the contract.

<u>PERCENT OF TOTAL CONTRACT AMOUNT EARNED</u>	<u>ALLOWABLE PERCENT OF THE LUMP SUM PRICE FOR THE ITEM</u>
1st Partial Estimate	25
10	50
25	75
50	100

No price adjustments will be made for this item due to changes in the work in accordance with Section 105.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided by the contract.

Payment will be made under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1202(1)	Mobilization	Lump Sum

SECTION 1203

EROSION CONTROL SYSTEMS

1203.01 DESCRIPTION. This work consists of furnishing and placing erosion control systems in accordance with plan requirements for use as soil retention blankets on slopes or as flexible channel liners in ditches.

1203.02 MATERIALS.

(a) **General:** Erosion control systems shall comply with Subsection 212. The manufacturer's installation plan and hardware (staples, stakes, etc.) are considered part of the system and shall be the same as that used during the evaluation for source approval. The type of erosion control system to be used shall be shown on the plans. The contractor shall have the option of substituting a higher grade system for a lower grade system within the same application (slope protection or flexible channel liners) at no additional cost to the Department.

(b) **Acceptance:** Pretested lots of erosion control systems shall be accepted based on a Certificate of Delivery showing DOTD Lot Numbers and laboratory numbers representing the pretested material, including hardware. Erosion control systems that are not accompanied by a Certificate of Delivery shall be sampled in accordance with DOTD S613 at the rate of 1/200 rolls for rolled type materials (or mats) or 1/200 bags for mulch systems per manufacturer's lot. The sample size shall consist of not less than 3 square yards (sq m) of rolled (or mat) material or one 50 lb (20 kg) bag of mulch. Installation hardware, additives such as tackifiers, and any other component of the system not covered above shall be sampled at the rate of one item/type/size or one quart (L) per manufacturer's lot in accordance with DOTD S601. A copy of the approved installation plan shall accompany each shipment to the project.

(c) **Packaging:** Materials shall be packaged in such a way as to maintain the quality of the product throughout handling. Each package shall be identified with the manufacturer's name, product name, and manufacturer's lot number. Each package that is represented by a Certificate of Delivery shall also be identified by the DOTD Lot Number corresponding to that shown on the Certificate of Delivery.

1203.03 EQUIPMENT. Equipment necessary to satisfactorily perform the work shall be furnished and maintained by the contractor. Equipment for hydraulically applying fiber mulch shall be equipped to eject the thoroughly wet mulch material at a uniform rate equal to the manufacturer's recommendations or as designated by the plans to provide the mulch coverage specified.

1203.04 CONSTRUCTION REQUIREMENTS. Erosion control systems shall be installed in accordance with the approved installation plan, no later than 48 hours after completion of seeding or sodding operations. All staples shall be installed flush to the ground and shall penetrate all layers of overlapped or adjacent rows.

(a) **Slope Protection:** Slopes shall be constructed to the required grade, fertilized, and seeded prior to application of erosion control systems. At the time of coverage, the area to be covered shall be free of ruts, clods, stones, roots or other foreign matter that will prevent close contact of the blanket with the soil. Rolled products or mats with netting only on one side are to be placed with the netting exposed and the fibers in contact with the soil.

(b) **Flexible Channel Liners:** Channels shall be prepared in accordance with Heading (a). Flexible channel

liners shall be placed beginning at the downstream end.

I203.05 MAINTENANCE. The contractor shall maintain the areas on which erosion control systems have been placed until final acceptance of the project. This shall consist of the repair of damage by erosion, wind, fire or other cause. Such areas are to be repaired to reestablish the condition that existed prior to placing the erosion control systems and may include fertilizing, seeding, mulching or sodding as required at no direct pay.

I203.06 MEASUREMENT. Erosion control systems, including hardware, will be measured by the square yard (sq m) of surface area covered.

I203.07 PAYMENT. Payment for erosion control systems will be made at the contract unit price and includes all materials, labor, equipment and other incidentals necessary to complete the work. Required burial of ends and edges, overlaps and hardware will not be measured for payment. Payment will be made under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
I203-01	Erosion Control System (Type)	Square Yard (Sq m)

PART 13 - TRAFFIC

SECTION 1301

TRAFFIC SIGNS AND DEVICES

1301.01 DESCRIPTION. This work consists of furnishing and installing traffic signs, dead end road installations, markers and delineators, with accessories, posts and overhead spans of specified materials, sizes, shapes, weights and designs. In general, the work and materials shall comply with the MUTCD as modified by these specifications or as shown on the plans. Signs shall be fabricated in an approved plant. The term "legend" shall mean border strip, letters, numerals and symbols which convey the message on signs.

1301.02 MATERIALS. Materials shall be new stock conforming to the following:

(a) Sign and Marker Sheeting: Sheeting material for sign panels, delineators, barricades and other markers shall comply with Section 215. All permanent signs shall meet the requirements of ASTM D 4956, Type III, except as follows:

Reflective sheeting for the permanent signs of Table 1301-I shall meet the requirements of DOTD Type VIII.

**Table 1301-I
Permanent Signs for Use with DOTD Type VIII Reflective Sheeting**

Sign	MUTCD Number
Stop	R1-1
Yield	R1-2
4-Way	R1-3
All Way	R1-4
Do Not Enter	R5-1
Wrong Way	R5-1a
Chevrons	W1-8
No Passing Zone Pennants	W14-3
Type 3 Object Marker	OM-3 (Right & Left)
Type 2 Object Marker	OM-1 (Horz. – Vert.) OM-2 (Horz. – Vert.)
Guardrail End Decals	-----

(b) Ferrous Metal: Ferrous metals shall comply with Subsection 215.02(a). Reinforcing steel shall comply with DOTD Section 1009. Ferrous metal, except reinforcing steel, shall be galvanized in accordance with DOTD Section 811.

(c) Aluminum: Aluminum alloys for structural members shall comply with Subsection 215.02(b). Aluminum sign panels shall comply with Subsection 215.04(a).

(d) Fittings: Structural bolts, nuts, washers and miscellaneous hardware shall comply with Subsection 215.02(c).

(e) Guard Rail: Guard rail materials for dead end road installations shall comply with Section 207.7.

(f) Timber: Treated piling and timber for barricades in dead end road installations shall comply with Section 205.

(g) Concrete: Concrete shall be Class M complying with DOTD Section 901.

(h) Flexible Sign Posts: Flexible posts for small signs, markers and delineators shall comply with Subsection 215.03.

(i) **Silk Screen Paste:** Silk screen paste shall be as recommended by the sheeting manufacturer.

(j) **U-Channel Posts:** U-channel posts shall comply with Subsection 215.02(a)(3).

1301.03

GENERAL REQUIREMENTS.

(a) **Sign Face Fabrication:** Signs of Types A, B, D and E, overhead signs and sign face overlay panels shall be fabricated in accordance with the MUTCD, the "Standard Highway Signs" booklet, and the signing detail sheets of the plans. The contractor shall furnish shop drawings of sign faces for Types D and E, overhead signs and sign overlay panels and for any non-standard sign faces of Types A and B not provided by the Department. Approval of shop drawings shall be obtained before sign face fabrication is begun.

(b) **Sign Mountings Fabrication:** The contractor shall have the option of furnishing either steel or aluminum sign supports for both post mountings and overhead mountings and either rigid steel or flexible posts for small signs, markers and delineators. Before beginning work, the contractor shall notify the engineer in writing of signing materials he proposes to furnish. The same signing materials shall be used throughout the project. Fabrication of sign mountings shall conform to DOTD Section 807. The contractor shall furnish fabrication and erection drawings of all sign mountings in accordance with DOTD Subsection 801.03 with the exception of standard roadside installations. Fabrication and erection drawings will be approved only after approval of sign face shop drawings. Neither fabrication of sign mountings nor construction of sign footings will be allowed before drawings are approved and distributed.

An approved damper is required for each aluminum truss. Dampers shall be installed during truss fabrication and shall remain in place.

Structure mounted delineator and milepost assemblies shall be installed in accordance with plan details. Welding shall comply with DOTD Section 815.

(c) Material Sampling and Certification:

(1) **Sign Faces:** All materials used in the fabrication of sign faces will be sampled by the Construction Fabrication Inspector in accordance with Section 1301 of the DOTD Materials Sampling Manual. Project sign faces will be accepted by the Department's sign inspection team and will be certified by the Construction Fabrication Inspector. Incidental sign faces will bear the stamp of the Construction Fabrication Inspector.

(2) **Sign Mountings:** All materials used in the fabrication of sign mountings will be sampled by the Construction Fabrication Inspector in accordance with Section 807 of the Materials Sampling Manual. All approved sign mountings and supports will bear the stamp of the Construction Fabrication Inspector.

(3) **U-Channel Posts:** U-channel posts will be sampled either by the Project Engineer or the Construction Fabrication Inspector in accordance with Section 1301 of the Materials Sampling Manual. U-channel posts not certified by the Construction Fabrication Inspector will be sampled by the Project Engineer.

1301.04 FABRICATION OF SIGN PANELS AND MARKERS.

(a) **General:** The completed product shall have a surface free of cracks, blisters, blemishes, and wrinkles. Metal fabrication including shearing, cutting and punching of holes shall be completed prior to surface treatment of metal and application of sheeting. Metal panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs and defects resulting from fabrication. Surface of sign panels shall be flat.

Splice plates joining sign panels shall not extend behind horizontal sills. Flat aluminum panels shall be a nominal 0.080 inch (2 mm) thick. Extruded aluminum panels shall be 12 inches (300 mm) wide and have a nominal face thickness of 0.125 inches (3 mm).

(b) **Surface Treatment:** Surface treatment shall be as specified herein or in accordance with approved recommendations of the reflective sheeting manufacturer.

(1) Degreasing:

a. **Vapor Degreasing:** Panels shall be immersed in a saturated vapor of organic solvent. Trademark printing shall be removed with lacquer thinner or a controlled alkaline cleaning system.

b. **Alkaline Degreasing:** Panels shall be immersed in a tank containing alkaline solutions, controlled and titrated to the solution manufacturer's specifications. Immersion time shall depend

upon amount of contaminants present and thickness of metal. **(2) Etching:**

a. Acid Etch: The panels shall be etched in a 6 to 8 percent phosphoric acid solution at 100°F (38°C). The panels shall then be rinsed thoroughly with running cold water followed by hot water tank rinse.

b. Alkaline Etch: Etch precleaned aluminum surface in an alkaline etching material controlled by titration, using time, temperature and concentration specified by solution manufacturer. Rinse thoroughly. Remove smut with an acidic, chromium compound solution specified by solution manufacturer and thoroughly rinse.

(3) Drying Panels: Panels shall be dried with a forced hot air drier. Panels shall be handled with clean canvas gloves or by other approved methods between cleaning and etching operations and sheeting application. Cleaned panels shall be protected from grease, oil or other contaminants prior to application of reflective sheeting.

(c) Sheeting Application: Application of reflective sheeting shall be in accordance with the approved written recommendations of the sheeting manufacturer. Sheeting shall be applied to sign faces in an orientation that will result in optimum retroreflectance, or as directed by the engineer.

Reflective sheeting shall be applied with no horizontal splices. Reflective sheeting applied directly to extruded panels shall have no more than two vertical splices per sign, with no more than one vertical splice per individual panel. When splices are used in this manner, only those that occur during, and as a part of, the manufacturing process will be allowed. Fabricated splices will not be allowed.

DOTD Type VIII reflective sheeting shall be applied with an orientation determined by the engineer to obtain the optimum entrance angle performance. Fabricated vertical splices in DOTD Type VIII reflective sheeting will be allowed only when the horizontal dimension of the sign face or attached shield is in excess of the maximum manufactured width of the sheeting. Fabricated vertical splices in DOTD Type VIII reflective sheeting will also be allowed when the specified orientation will create excessive sheeting waste.

Sign faces comprised of two or more pieces of reflective sheeting shall be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance, both day and night. Alternate, successive width sections of either sheeting or panels shall be reversed and consecutive to ensure that corresponding edges of reflective sheeting lay adjacent on the finished sign. Reflective sheeting splices and sign edges shall be sealed in accordance with the manufacturer's recommendations. Legend shall be of the shape, size, dimension, and stroke specified in the MUTCD and sign face shop drawings. Legend shall be applied by one of the following methods:

(1) Direct Applied: Legend shall be an adhesive coated reflective sheeting as specified in Subsection 215.05. Legend shall be applied in such manner as to provide a wrinkle-free surface.

(2) Demountable: Legend shall be an adhesive coated reflective sheeting as specified in Subsection 215.05, permanently adhered to a 0.032-inch (0.8 mm) thick flat aluminum backing, except that route marker shields shall be 0.080-inch (2.0 mm) thick aluminum. Aluminum shall be treated in accordance with Heading (b). Legend shall be attached to sign face in such manner as to provide a smooth, flat surface. Sign fabrication rivets that prohibit such application shall be removed and replaced through legend, or legend may be raised by approved spacers. Legend shall show clean cut, uniform width of stroke and have essentially a plane surface.

(3) Screened: Legend shall be applied to sign faces by an approved screening process in accordance with the reflective sheeting manufacturer's recommendations. Screen pastes shall be compatible with reflective sheeting and shall not reduce reflectivity of sheeting less than the values shown in Subsection 215.05(c). Completed screen surface shall be uniform in color, have sharp edges, be free of bubbles and blemishes, streaks or livered areas, and show good workmanship.

(4) Overlay Film: Legend shall be applied to the sign faces by an approved transparent electronic cuttable overlay film that is compatible with the reflective sheeting to which it is applied. Application shall be in accordance with the recommendations of the manufacturer(s) of both the film and the reflective sheeting. Areas covered by film shall have sharp edges, be free of bubbles and blemishes and show good workmanship. This material shall be in accordance with Subsection 215.07(c). Direct or reversed application will be permitted.

(d) Screening Process: Screening of sign faces shall be in accordance with Subsection 215.07(b). Screening shall be by direct or reverse silk screen methods accomplished in the manner specified by the sheeting manufacturer. Screening on sheeting may be accomplished either before or after application of sheeting to panels.

(e) Packaging: Before being packed, signs shall be allowed to stand for at least 12 hours after completion of screening. Signs shall be slipsheeted and packed in such manner as to ensure their arrival at their destination in an undamaged condition. Packaged signs shall not be permitted to become wet during storage or shipment.

1301.05 CONSTRUCTION REQUIREMENTS. When removal of existing signs is required, the contractor's sign removal operations shall be coordinated as directed with new sign construction to provide for adequate signing to be in place at all times.

(a) Sign Location: Sign support locations will be as shown on the plans or as directed. Sign locations, after initial staking by the contractor, must be approved by the engineer. Sign locations which are obviously improper because of topography, existing appurtenances or other conflicting conditions will be adjusted to the closest desirable location. The contractor shall then determine elevations for post length determinations at the established sign support location. The contractor shall be responsible for orientation, elevation, offset and leveling of signs.

(b) Sign Positioning:

(1) Overhead Signs: Signs shall be constructed so that the top edge of the sign face is tilted towards oncoming traffic 3 degrees (approximately 1:20) from vertical and at right angles to the road, unless otherwise directed

(2) Road Edge Signs: Road edge signs shall be constructed with sign faces vertical. Sign faces located less than 30 feet (9 m) from the edge of travel lane shall be placed at a 93 degree angle from the center of the travel lane. Sign faces located 30 feet (9 m) or more from the edge of the travel lane shall be placed at an 87 degree angle from the center of the travel lane. Where the lanes divide or are on curves or grades, sign faces shall be oriented to be most effective both day and night and avoid specular reflection.

(3) Delineator, Object Marker and Milepost Assemblies: These assemblies shall be placed at least 24 inches (600 mm) beyond the outer edge of roadway shoulder, 24 inches (600 mm) beyond the face of curb, or in the line of guard rail.

(4) Vertical and Horizontal Clearances: Vertical and horizontal clearances shall be in accordance with the MUTCD and/or shall be as shown on the plans.

(c) Sign Overlay Panels: When specified, existing signs shall be completely overlaid with new sign panels placed over the existing sign face. No partially overlaid signs shall be allowed to remain exposed overnight. Only one overlay shall be placed on a sign. When an overlay is to be placed on an existing overlaid sign, the previous overlay shall be removed prior to placement of the new overlay. Overlay panels shall conform to Section 1301.04.

Raised legends shall be removed from the existing sign face prior to placing the overlay panel. The size of the overlay panel shall not exceed the size of existing sign panel by more than 3 inches (75 mm) on any side. Overlay panels shall be attached to the existing sign with rivets complying with Subsection 215.02. Rivets shall be placed on 12-inch (300 mm) centers (maximum) along the perimeter of panel and at panel splices, and on 24-inch (600 mm) centers (maximum) both vertically and horizontally in interior portions of each panel. Rivets shall be centered horizontally on panels less than 24-inch (600 mm) wide. A 4 by 4-inch (100 mm by 100 mm) shim with a nominal 0.080-inch (2.0 mm) thick aluminum plate shall be placed between existing panel and overlay panel at interior rivet locations. Shims cut from salvaged sign panels may be used.

The existing sign panels shall be kept reasonably flat during installation of the overlay panels. Splice arrangement for overlay panels shall conform to the requirements for traffic sign blanks.

(d) Excavation and Backfill: The contractor shall perform excavation for sign installation to levels and dimensions shown on the plans, or as directed. Excavation and backfill shall be performed in accordance with DOTD Section 802.

(e) Footings: Foundation piles, concrete, reinforcing steel and anchor bolt assemblies shall comply with DOTD Sections 804, 805, 806 and 807.

Posts for ground mounted delineator, object marker and milepost assemblies may be driven; no footings will be required.

(f) Bolt Tensioning: Slip plates for breakaway sign posts shall be assembled in the shop with high strength bolts tightened at a minimum bolt tension in accordance with DOTD Subsection 807.21. After field installation, high strength bolts in the breakaway base connection shall be tightened to the specified minimum bolt tension. The bolt tension in both the slip plate connection and the breakaway base connection will be checked by the engineer. Bolt tensioning shall be corrected as required.

(g) Cleaning and Clearing: Prior to erection, sign faces shall be cleaned to allow adequate visibility of the sign. Any clearing or tree trimming required to provide for full sign visibility shall be in accordance with the plans or as

directed. Trimming of trees of significant local interest shall be performed by a licensed arborist.

(h) U-Channel Posts: U-channel posts for ground mounted small signs, markers and delineators shall be driven vertically to a minimum depth of 3 feet (1 m) below natural ground using a suitable protective driving cap. U-channel posts may be spliced where long lengths are required. The upper section shall overlap the lower section by at least 24 inches (600 mm).

The bottom edge of the upper section of the splice shall be a minimum of 24 inches (600 mm) above the ground. The spliced sections shall be secured with at least four 5/16 inch (8 mm) diameter hex head bolts spaced equally along the splice. Splicing of U -channel posts will not be allowed when break-away footings are required.

1301.06 DEAD END ROAD INSTALLATIONS. Dead end road installations shall be of the specified type and located as shown on the plans. Timber barricade type installations shall be constructed in accordance with DOTD Section 812 and the following requirements. Timber piling shall be set in full depth holes and backfilled as directed or driven to required depth. Steel posts for other type installations shall be driven with a suitable protective cap. Piles and posts shall be vertical. Guard rail shall be constructed in accordance with DOTD Section 704.

1301.07 ACCEPTANCE OF SIGNS. After the installation of signs is complete, the engineer or an authorized representative shall perform a daytime and nighttime inspection of the signs, sign faces, mounts, installations, hardware and matters relating to the requirements of this section. After this inspection, the engineer and the Department's Sign Inspection Team shall inspect for color match and for conformance to applicable plans, standards and project specifications. Color match, uniformity and spacing of legend, specular glare, and sign type and design will be inspected for conformance to plans and specifications.

When specular reflection is apparent on any sign, its positioning shall be adjusted by the contractor to eliminate this condition. Signs shall be clean at the time of inspection. Reflective sheeting shall be free of cuts, scratches, breaks or other defects which might allow moisture to infiltrate and damage reflective cells. Nonstandard or otherwise unacceptable signs and traffic control devices shall be replaced or repaired as directed. The contractor will be required to correct damage that is discovered at the time of the sign inspection. When the damage was obviously caused by vandalism, the contractor will be paid for corrective work in accordance with DOTD Subsection 109.04.

In lieu of removing and replacing new sign faces that have been rejected, sign overlay panels complying with Subsection 1301.05(c) may be used to correct the deficiencies at no direct pay.

1301.08 MEASUREMENT.

(a) Sign Faces and Overlay Panels: Quantities for payment will be the design areas in square feet (sq m) of sign faces as specified on the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are made. Material used in blanks and backing incidental to the sign face will not be measured for payment. In determining the area of sign faces, no deductions are made for corner radii or mounting holes. The area of octagonal signs and Interstate shields is computed as the area of its smallest rectangle or square. The area of triangular signs is computed as the area of the triangle.

(b) Post Mountings: Post sign mountings, including breakaway supports, will be measured per each post.

(c) Overhead Mountings: Overhead sign mountings will be measured per each structure.

(d) Delineator, Object Marker and Milepost Assemblies: Delineator, object marker and milepost assemblies will be measured per each assembly.

(e) Dead End Road Installations: Dead end road installations will be measured per each installation.

(f) Footings: Concrete footings for overhead sign mountings will be measured per each footing. Footings and aprons for post sign mountings will not be measured for payment.

(g) U-Channel Posts: U-channel posts will be measured per each unit installed when not part of an assembly.

(h) Clearing or Tree Trimming: Any clearing or tree trimming required by this section which is not provided for elsewhere in the contract will be included in the contract unit price for signs.

1301.09 PAYMENT.

(a) Sign Faces and Overlay Panels: Payment for sign faces and overlay panels will be made at the contract unit price per square foot (sq m), which includes furnishing, fabricating and constructing the signs and furnishing necessary attaching devices.

(b) Post Mountings: Payment for post sign mountings will be made at the contract unit price per each, which includes furnishing, fabricating and constructing the support complete, ready for affixing signs, and includes

required excavation, concrete and reinforcement for footings and aprons, and the sign mounting. Payment for sign layout will be made in accordance with DOTD Section 740.

(c) Overhead Mountings: Payment for overhead sign mountings, including bridge fascia mountings, will be made at the contract unit price per each, which includes furnishing, fabricating and erecting the structure complete, ready for affixing signs, and the sign mounting.

(d) Delineator, Object Marker and Milepost Assemblies: Payment for delineator, object marker and milepost assemblies will be made at the contract unit prices per each, which includes posts.

(e) Dead End Road Installations: Payment for dead end road installations will be made at the contract unit price per each, which includes piling, posts, barricades, sign materials, reflectors, and any required guard rail.

(f) Footings: Payment for footings for overhead sign mountings will be made at the contract unit price per each, which includes excavation, piling, concrete, reinforcing steel, anchor bolt assemblies and backfill. The concrete in footings will be identified by lots and shall be subject to pay adjustments in accordance with DOTD Table 901-4 and Note 2 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual.

(g) U-Channel Posts: Payment for U-channel posts will be made at the contract unit price per each which shall include all labor, equipment, tools, materials, and incidentals necessary to complete the work, including splicing of posts, and when required removing and remounting of existing signs, and mounting of new signs. Payment will be made under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
1301-01	Sign (Type A)	Square Foot (Sq m)
1301-02	Sign (Type B)	Square Foot (Sq m)
1301-03	Sign (Type C)	Square Foot (Sq m)
1301-04	Sign (Type D)	Square Foot (Sq m)
1301-05	Sign (Type E)	Square Foot (Sq m)
1301-06	Sign (Overhead Mounted)	Square Foot (Sq m)
1301-07	Sign (Overlay Panel)	Square Foot (Sq m)
1301-08	Mounting (_____Size Post)	Each
1301-09	Mounting (Overhead Truss) (Ground Mounted)	Each
1301-10	Mounting (Overhead Truss) (Structure Mounted)	Each
1301-11	Mounting (Overhead Cantilever) (Ground Mounted)	Each
1301-12	Mounting (Overhead Cantilever) (Structure Mounted)	Each
1301-13	Mounting (Bridge Fascia Mounted)	Each
1301-14	Delineator Assembly (Ground Mounted)	Each
1301-15	Delineator Assembly (Structure Mounted)	Each
1301-16	Milepost Assembly (Ground Mounted)	Each
1301-17	Object Marker Assembly	Each
1301-18	Milepost Assembly (Structure Mounted)	Each
1301-19	Dead End Road Installations (Type)	Each
1301-20	Footings for Overhead Mounting (Type)	Each
1301-21	U-Channel Post	Each

SECTION 1302

TRAFFIC CONTROL COMPONENTS

1302.01 DESCRIPTION. This work consists of furnishing and installing necessary materials and equipment to complete new traffic signal systems or modify existing systems in accordance with plan details and these specifications. Unless otherwise specified, all materials shall be new. When existing systems are to be modified, the existing material shall be incorporated in the revised system, salvaged or abandoned, as specified. Incidental parts which are not shown on the plans, specified herein or in the project specifications, and which are necessary to complete the traffic signal or other electrical systems or required for modifying existing systems, shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be complete and in operation to the satisfaction of the engineer at the time of final acceptance.

1302.02 MATERIALS. Materials shall comply with the following sections and subsections:

- Usable Soil 203.1
- Portland Cement Concrete, Class A
- Reinforcing Steel 207
- Precast Reinforced Concrete Junction Boxes and Manholes 605
- Manhole Frames and Covers 207
- Ground Rods 213
- Rigid Metal Electrical Conduit 213
- Electrical Conductors 213
- Traffic Signal Heads 213
- Traffic Detectors and Associated Equipment 213
- Traffic Signal Hardware and Equipment 213
- Pedestal Anchor Bolts 213
- Support Cable 213
- Guy Components 213
- Traffic Signal Cable 213
- Electrical Junction Boxes 213
- Poles for Traffic Signal Systems 213
- Steel Standards and Mast Arms 213

Controllers shall comply with the specifications entitled "TRAFFIC SIGNAL CONTROL SYSTEM, TRAFFIC CONTROL STANDARD NUMBER 18A", contained elsewhere herein.

Traffic detectors and associated equipment shall be included in the "TRAFFIC SIGNAL CONTROL SYSTEM, TRAFFIC CONTROL STANDARD NUMBER 18A", unless otherwise noted on the plans.

1302.03 REGULATIONS AND CODE. Electrical equipment shall comply with the latest standards of the NEMA or the RMA, whichever is applicable. In addition to the requirements of these specifications, the plans, and the project specifications, material and work shall comply with the latest requirements of NFPA No. 70 National Electrical Code and ANSI C2 National Electrical Safety Code, the Standards of ASTM, ANSI, MUTCD, ITE and IMSA. The term code as referred to in this Section shall be the NFPA No. 70, National Electrical Code, and ANSI C2, National Electrical Safety Code. Discrepancies between codes or standards and these specifications, shall be resolved in accordance with

Subsection 105.4.

1302.04 GENERAL REQUIREMENTS. The contractor shall verify the location of existing utilities prior to construction. The contractor shall verify the practicality of the location, elevation, and orientation of foundations for poles and pedestals prior to ordering materials.

Traffic control equipment to be salvaged shall be protected during removal and delivery to the specified location. Equipment not to be salvaged shall become the property of the contractor.

The contractor shall use the existing equipment or provide traffic signal equipment during the period of construction for continuous operation of the signal system at no direct pay. Traffic control operations and construction shall be in accordance with the plans or these specifications. Operational differences shall be submitted in writing and approved in advance by the Traffic Engineer. The contractor shall provide police supervision of traffic at any time the traffic signal system is not in operation at no direct pay.

Minimum clearances for traffic signal supports and apparatus shall be in accordance with the MUTCD. Poles shall be located a minimum of 24 inches (600 mm) outside the shoulder or a minimum of 10 feet (3 m) outside the edge of the travelway whichever is greater.

The contractor shall provide drawings and equipment submittals in accordance with DOTD Subsection 730.04, except that the submittal shall be to the Traffic Services and Operations Engineer instead of the Bridge Design Engineer. Shop drawings and submittals shall include cam breakout details and circuit identifications.

Upon completion of signal and controller work, each cabinet shall contain a plastic envelope with a completed copy of the Traffic Signal Inventory Form, LA. DOTD TSI-I and a copy of the field wiring terminations pertaining to that intersection. The contractor shall submit to the District Traffic Engineer related documents including equipment manuals, traffic studies, copies of wiring diagrams, and manufacturer's certification letters, for each intersection prior to the new signals or signal modifications becoming operational.

1302.05 ELECTRICAL SERVICE. The contractor shall verify the location of the power source and arrange for electrical service in accordance with DOTD Subsection 730.09. Existing power service shall be used unless a new power source is indicated on the plans. The traffic signal control equipment shall be in the same quadrant as the power source. If the power source is not in the same quadrant, the contractor shall submit a detailed drawing of proposed changes for approval.

At each power source, a 1-inch (25 mm) diameter conduit with conductors shall be attached to the service pole and terminated with a threaded service entrance fitting (weatherhead) at a height designated by the power company. The wires shall extend a minimum of 24 inches (600 mm) beyond the weatherhead.

1302.06 FOUNDATIONS. Excavation for mast arm and strain pole foundations shall be drilled with an auger. Excavation for pedestal poles and controller foundations may be made with an approved auger or by hand. When a cave-in occurs during excavation, the contractor may continue excavating using casing or sleeving. Cave-ins shall be repaired before the foundation is placed. When subsurface obstructions are encountered, the contractor shall remove the obstructions or replace the excavated material and relocate the foundation, as directed, at no direct pay. Forms and ground which will be in contact with concrete shall be thoroughly moistened before placing concrete.

Foundations shall be cast monolithically. The exposed portions shall be formed to present a neat appearance. The bottom and sides of concrete foundations shall rest on firm undisturbed ground. Pole foundations shall be placed with the bored hole as the form. Backfill around a cast-in-place foundation will not be allowed. Tops of foundations for poles and signal supports, except special foundations, shall be finished at grade of curb top or sidewalk or as directed. Conduit ends and anchor bolts shall be placed in correct position and shall be held in place by a template.

Exposed surfaces of concrete shall receive a Class I, Ordinary Surface Finish in accordance with DOTD Subsection 805.13 except when the edge of a concrete foundation is within 18 inches (450 mm) of a sidewalk, the sidewalk section shall be in accordance with Section 706. The tops of mast arm foundations shall be level so the pole base will be in full contact and the pole will be vertical without the use of shims. Anchor bolts shall extend a minimum of 1/4 inch (6 mm) above the nut.

Conduits which terminate in anchor base type poles and pedestals shall extend approximately 3 inches (75 mm) above the foundation and shall be aligned toward the handhole opening. An additional 2-inch (50 mm) diameter conduit stub-out shall be installed in foundations for future use. The foundation shall be marked as shown on the plans to indicate the location of the additional conduit and grounding conduit.

1302.07 PEDESTAL POLES. The pedestal poles shall be installed plumb within 1 inch (25 mm) at the top. Pedestal poles not constructed within the 1 inch (25 mm) tolerance shall be removed and the foundation reconstructed at no direct pay. Shims will not be permitted on a new pedestal foundation. A total of 1/4 inch (6 mm) of shims will be permitted on existing foundations. When an existing pedestal pole cannot be shimmed within tolerance through no fault of the contractor, the existing foundation shall be replaced in accordance with Subsection 601.

1302.08 MAST ARMS. After installation and loading, mast arm shaft shall be plumb within 1 inch (25 mm) at the top. The end of the mast arm shall be a minimum of 5 feet (1.5 m) above the top of the shaft. The end of the mast arm shall be a minimum of 21 feet (6.4 m) above the bottom of the transformer base. The mast arms shall be installed with compression grommet bushing (CGB) connectors in bosses utilized for cabling.

1302.09 STRAIN POLES. Strain poles for the attachment of support cables shall be the anchor base type. Support cable shall be attached in accordance with Subsection 1302.12. Poles shall be plumb within 6 inches (150 mm) at the top after support cable tensioning in accordance with the plans.

1302.10 TIMBER POLES. Poles shall be set in holes drilled by an auger to a minimum depth of 6 feet (1.8 m). Auger diameter shall be approximately 4 inches (100 mm) greater than the pole butt diameter. The poles shall be plumb within 6 inches (150 mm) at the top after support cable tensioning in accordance with the plans. Backfill material shall be provided and compacted as directed.

Holes for the attachment of support cables shall be fitted with 5/8-inch (16 mm) diameter thimble-eye through-bolts and 2 1/2 inch (65 mm) square curved washers. Each pole shall have a continuous length of No. 8 AWG copper wire along the length of the pole. A minimum of 6 feet (1.8 m) of the copper wire shall be coiled and attached to the bottom of the pole forming a coil ground. The copper wire shall extend a minimum of 6 inches (150 mm) above the top of the pole. The wire shall be stapled with galvanized 1 1/2 inch (40 mm) staples at approximately 6-inch (150 mm) intervals beginning at the butt, then at approximate 12-inch (300 mm) intervals beginning at 12 feet (3.6 m) from the butt and continuing to the top of the pole. The poles shall be embedded in the ground a minimum of 20 percent of the pole length. Anchors shall be installed on new poles in accordance with the plans.

1302.11 GUY WIRE ASSEMBLIES. Guy wire shall be attached to the pole with a 5/8-inch (16 mm) diameter angle thimble -eye bolt of appropriate length through a lift plate fastened to the pole by two 3/8-inch (9.5 mm) diameter lag screws. The opposite side of the pole shall have a 2 1/2 inch (65 mm) square curved washer, a square nut, and a thimble-eye nut for termination of support cable. An additional square nut shall be used as a locking nut against the thimble-eye nut.

Hardware shall be tightened against the pole. Excess bolt length shall be sawn to within 1/4 inch (6 mm) of the nut and the galvanized coating repaired in accordance with Subsection 811.12. The guy assembly shall have strain insulator, thimble eye anchor rod, service sleeves, and screw-type anchors as shown on the plans. Installed anchors shall develop holding strength and be properly aligned to provide permanent stability to the installation. Guy assemblies shall be installed and tensioned before erection of signals so that they will resist the major portion of the horizontal loading.

1302.12 SUPPORT CABLE. Support cable with accessories shall be installed between two or more poles to provide support and attachment for traffic control equipment. Support cables shall be grounded. Accessories used with support cables shall include strain insulators and three-bolt clamps. Long strain insulators shall be used as needed for safety clearance and shall require approval when not shown on the plans. Attachments of the support cable shall be made with standard thimble-type hardware.

1302.13 VEHICLE AND PEDESTRIAN SIGNAL HEADS. Signals shall be vertical unless otherwise specified. Cable suspended heads shall be fitted with a universal hanger. Drop pipes will be allowed only when necessary to provide proper roadway clearance. Disconnect hangers shall be required for cable suspended heads. Mast arm mounted signals shall be installed using an approved adjustable rigid bracket.

Each bulb in the signal head shall be connected to an individual wire from the controller. Lamp sockets shall be rotated to position the open portion of the lamp filament upward. Each signal head shall be oriented to its lane or crosswalk and secured in place by a serrated or other locking device incorporated in signal housing and support hardware.

Supporting brackets on trunnions shall be used at the top and bottom of the section assembly to rigidly support all faces. Openings not used for mounting purposes shall be closed with approved threaded weatherproof plugs.

A minimum of 8 feet (2.4 m) between signal heads is required, measured between imaginary lines centered on each signal head parallel to the approach. The signal head shall be aimed within 3 degrees of parallel to the approach lane to which it applies, or as directed. Vehicular signal heads shall be covered with a sturdy opaque material until placed in service.

1302.14 VEHICLE LOOP DETECTOR INSTALLATION. Slots shall be sawed in the pavement for installation of vehicle detector loop wire in the configuration, dimensions, and combinations as shown on the plans. An extension from the loop to the pavement edge shall be cut to permit wire routing to an adjacent pullbox or conduit through a 1/2-inch (13 mm) conduit. Slots shall be cleaned of loose material. The engineer shall examine and approve the depth of each loop slot for conformance with the plans before the contractor places the loop wires in the slot. Wires shall be carefully placed in the slot. The number of turns of wire installed for each loop shall be as required. The wire shall be pushed carefully into the slots with a blunt tool to avoid damaging the insulation. No splices will be permitted in the loop installation except in the pull-box, conduit fittings or pole.

Wires from the pavement to the controller box shall be installed inside a conduit as shown on the plans. Wire installed from the pavement edge to the splice shall be twisted uniformly at 2 to 5 turns per foot (7 to 16 turns/m). The loop ends shall be spliced to a lead-in cable. The lead-in cable shall be connected inside the controller cabinet. The wires

shall be spliced using an approved connector and by soldering, then encapsulated with an approved electrically insulating waterproof epoxy as shown on the plans. The conduit shall not be filled with the approved insulating waterproof epoxy. The slots shall be completely filled to within 1/8 inch (3 mm) of the pavement surface with an approved sealant.

1302.15 PEDESTRIAN PUSHBUTTON. Pushbuttons shall be installed on poles or pedestals at locations where the signal head is visible from the pushbutton location. Push-buttons mounted on steel poles shall be serviced by wiring inside the poles. Wires shall be installed through a 3/4-inch (20 mm) diameter hole in the pole and through the back of housing and shall be installed with a rubber grommet. Unused conduit attachment holes shall be plugged. The housing shall be attached to the pole using machine or self-tapping screws.

Pushbuttons mounted on wood poles shall be wired through conduit. Pedestrian pushbutton signs shall be installed above the pushbutton.

1302.16 ELECTRICAL. Wires in cabinets shall be neatly laced into cables with nylon lacing or plastic straps. Conductors shall be installed in conduit except where the run is inside poles or suspended from support cable. After completion of field wiring, the conduit entering cabinets, pole bases, or junction boxes shall be sealed with a removable sealing material compatible with the cable jacket, insulation and conduit material.

Support cable, metallic cable sheaths, conduit, transformer cases, metal poles and pedestals shall be made mechanically and electrically secure and grounded. Bonding and grounding jumpers shall be No. 6 AWG copper wire. Equipment on wood poles shall be grounded. Cable from the circuit breaker at the service to the controller shall consist of a minimum of three No. 6 AWG THWN stranded copper wires.

Six feet (2 m) of spare signal, loop lead-in and communication cable shall be installed in each base-mounted cabinet. Field wiring shall be connected to terminals by one piece, screw-tightened lugs.

Aerial signal cable shall have a drip loop extending at least 6 inches (150 mm) below the entrance. The aerial signal cable and drip loop shall not chafe on the equipment.

Signal cable shall be installed between signal heads and controller cabinets. When specified, interconnect and/or communication cable shall be installed between controller cabinets of different intersections. Signal, interconnect, and/or communication cable may be lashed to support cable or installed in underground conduit as shown on the plans. Lashing material shall be stainless steel for interconnect and aluminum for signal cable.

1302.17 CONDUIT INSTALLATION. Underground wiring shall be enclosed in conduit. Conduit connections shall use threaded couplers and shall be sealed with a waterproof sealant. Coupling of new conduit to existing conduit shall be with a three-piece coupling. Threads shall be clean cut, straight and true, and of sufficient length to permit full-depth coupling. Excessive threads will not be permitted. Ends of conduit installed for future connections shall be threaded, reamed and capped. Couplings shall be tightened until the conduit ends are together.

Damaged coatings in exposed threads shall be repaired in accordance with DOTD Subsection 811.12. Exposed threaded ends of conduit shall be terminated with an insulated-throat, ground-type bushing.

Backfilling shall be with usable soil, placed and compacted to at least the density of the surrounding ground at no direct pay. After installation, conduits shall be tested for clearance with a 2 inch (50 mm) long mandrel having a diameter 1/4 inch (6 mm) smaller than the inside diameter of the conduit. Conduits not allowing passage of the mandrel will be

rejected. The contractor may install larger size conduit at no direct pay. No reducing couplings will be permitted in a conduit run.

Underground conduits shall be buried a minimum of 18 inches (450 mm) below the surface. Conduits for loop detectors shall be installed parallel to existing or proposed curbs and a maximum of 24 inches (600 mm) behind the back of curb or as directed. Conduit shall be jacked or bored under existing pavements and within the drip line of trees in accordance with DOTD Section 728.

1302.18 CONTROL EQUIPMENT. Field wiring in controller cabinets and bases shall be neatly arranged, lashed into cables, routed to the appropriate terminal blocks, and permanently identified near the terminal. Controller equipment programming shall be provided by the contractor. When the information supplied by the City Traffic Engineer is insufficient for functional operation of the installed equipment, the contractor shall notify the engineer in writing of the problem identifying discrepancies, and proposing specific remedies or corrections. After programming, controller equipment operations shall be tested with the signals off, using the signal shutdown switch.

1302.19 JUNCTION BOXES. Junction boxes, when shown on the plans, are required a minimum of every 150 feet (45 m) in a conduit run. Backfilling shall be with usable soil, shall conform to DOTD Subsection 701.08, and shall be placed and compacted to the density of the surrounding ground at no direct pay. All metal covers and conduits shall be bonded together. Electrical conductors shall be installed clear of the metal frames and covers. Pull box fittings shall be used on conduit longer than 180 feet (55 m). Pull box fittings shall be installed at a minimum spacing of 90 feet (27 m).

1302.20 EQUIPMENT TESTING.

(a) Manufacturer's Tests: When design tests are specified herein, additional tests will not be required if documentation is provided indicating that such tests have been previously completed. Equipment shall be subject to factory demonstration tests and design approval tests at a location agreed upon by the contractor and the City Traffic Engineer. The City Traffic Engineer reserves the right to have its representative witness all factory demonstration tests and design approval tests.

Performance tests may be required on equipment not previously tested or approved. The City Traffic Engineer will not be responsible for time lost or delays caused by sampling and testing prior to final approval of any item. The contractor shall conduct special tests when equipment or systems are suspected of improper operation, or when additional data is necessary to determine proper operation or conformance with specifications. A test shall be performed on the completely assembled equipment, cabinet, and control equipment by the manufacturer prior to shipment. Malfunctions or defects shall be corrected and the equipment retested.

The complete log beginning with the first test, showing the results of the test shall be delivered with the equipment. The test shall require the operation of the equipment with each signal circuit connected to an incandescent load of a minimum of 600 watts. The equipment shall operate sequentially and continuously for a minimum of 48 hours as stated above in an environment having a minimum temperature of 140°F (60°C).

- (b) **Insulation Tests:** Insulation tests shall be made between conductors and ground and between conductors. Tests shall be made after the conductors are installed and before connecting equipment that may be damaged by the tests. Readings below 50 megohms, when measured with a 1000 volt D.C. insulation tester, will be considered defective.
- (c) **Test Documentation:** Documentation shall include a Certificate of Compliance, two sets of cabinet wiring drawings, and technical manuals for the control equipment. Cabinet drawings shall be DOTD standard blue line copies, with the manufacturer's name, equipment model number, project number, sheet number, date and revision block.

I 302.21 MEASUREMENT.

- (a) **Trenching and Backfilling:** Trenching and backfilling will be measured by the linear foot (lin m) of excavated trench backfilled and accepted.
- (b) **Conduit with Conductors:** Conduit with conductors will be measured by the linear foot (lin m) of conduit with conductors installed and accepted. Measurement will include conduit, conductors, clamps, fittings, above ground junction boxes, and miscellaneous hardware required for a complete conduit installation.
- (c) **Jacking or Boring Conduit:** Jacking or boring conduit will be measured by the linear foot (lin m) of conduit jacked or bored. Measurement will include fittings, excavation, backfilling and duct markers.
- (d) **Signal Support:** Signal supports will be measured per each signal or strain pole installed and accepted. Measurement will include the pole, mast arm, base assembly, guy wires and hardware, signal support cables and hardware, traffic signal cables inside pole, concrete foundation, reinforcing steel, conduits in foundation, ground rod, ground wires, ground clamp, hardware, drilled excavation, backfill, grout, electrical oxide-inhibiting compound and disposal of excess excavated material.
- (e) **Signal Heads:** Signal heads will be measured per each head installed and accepted. Measurement will include disconnect hangers, traffic signal wiring attached to overhead span, closure caps, mounting hardware, lamps, head programming, mounting connections and hardware.
- (f) **Signal Service:** Signal service will be measured per each service assembly installed and accepted. Measurement will include pole, disconnect, ground rod, wire and conduit on service pole, conduit and conductors on utility company pole, and connections and hardware required.
- (g) **Traffic Signal System:** Traffic signal systems will be measured on a lump sum basis, which will include furnishing and installing all equipment and apparatus, and performing work required for a complete system.
- (h) **Signal Controller:** Signal controllers will be measured per each controller installed and accepted. Measurement will include all electronic control equipment specified, prewired cabinet, foundation, conduits in foundation, ground rod assembly, anchor bolts and hardware, connections, documentation, programming, and testing.
- (i) **Loop Detector:** Detectors will be measured by the linear foot (lin m) of sawn slot. Measurement will include sawing, installed wire and sealing. Measurement will be made from the edge of the pavement and once around each loop perimeter.
- (j) **Underground Junction Box:** Underground junction boxes will be measured per each box installed and accepted. Measurement will include the box, cover, excavation, backfill and any concrete patching required.
- (k) **Conduit:** Conduit will be measured by the linear foot (lin m) point to point of conduit installed and accepted. Measurement will include conduit (including conduit within junction boxes), clamps, fittings, above ground junction boxes, and all miscellaneous hardware required for a complete conduit installation.

- (l) **Conductors:** Conductors will be measured by the linear foot (lin m) of conductor installed and accepted. Measurement will include conductor, clamps, connectors, and all miscellaneous hardware required for a complete conductor installation.
- (m) **Cable:** Cable will be measured by the linear foot (lin m) of cable installed and accepted. Measurement will include cable, clamps, connectors, and all miscellaneous hardware required for a complete cable installation.

I302.22 PAYMENT. Payment for traffic signal work will be made at the contract unit prices. The concrete in foundations for signal supports, signal controllers, and other signal equipment will be identified by lots and shall be subject to pay adjustments in accordance with DOTD Table 901-4 and Note 2 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual. Payment will be made under:

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
I302(1)	Trenching and Backfilling (Size & Type)	Liner Foot
I302(2)	Conduit with Conductors (Size & Type)	Liner Foot
I302(3)	Jacking or Boring Conduit	Liner Foot
I302(4)	Signal Support (Size & Type)	Each
I302(5)	Signal Heads (Type)	Each
I302(7)	Signal Service	Each
I302(8)	Traffic Signal System	Lump Sum
I302(9)	Signal Controller	Each
I302(10)	Loop Detector	Liner Foot
I302(11)	Underground Junction Box	Each
I302(12)	Conduit (Size & Type)	Liner Foot
I302(13)	Conductor (Size & Type)	Liner Foot
I302(14)	Cable (Size & Type)	Liner Foot

SECTION 1303

PLASTIC PAVEMENT MARKINGS

1303.01 DESCRIPTION. This work consists of furnishing and placing reflective pavement markings of hot applied thermoplastic or preformed cold applied plastic at the locations shown on the plans or as directed, in compliance with the MUTCD, plan details and these specifications.

1303.02 MATERIALS.

- (a) Thermoplastic Markings:** Thermoplastic marking material shall be a plastic compound reflectorized by internal and external application of glass beads, complying with Subsections 215.10 and 215.13, respectively. Width and color of markings shall be as specified.

Thermoplastic material shall be delivered in containers of sufficient strength to permit normal handling during shipment and transportation without loss of material. Approved heat-degradable containers that can be placed in heating kettles along with the plastic material will be permitted. Each container shall be clearly marked to indicate color of material, process batch number, name of manufacturer and date of manufacture. Glass beads used in drop-on application to molten plastic shall be shipped in sacks of multiply paper or burlap, both with a polyethylene liner. The sacks shall be strong enough to permit handling without damage, and have a capacity of 50 pounds (23 kg) of beads. Sacks shall be sufficiently water-resistant so that beads will not become wet or caked in transit.

- (b) Preformed Plastic Markings:** Preformed plastic markings shall comply with Subsection 215.11.

1303.03 CONSTRUCTION REQUIREMENTS.

- (a) Equipment for Thermoplastic Markings:** Material shall be applied to pavement by either spray or extrusion methods. Equipment shall provide continuous mixing and agitation of material. Conveying parts of equipment between main material reservoir and discharge mechanism shall prevent accumulation and clogging. Parts of equipment which come in contact with the material shall be easily accessible for cleaning and maintaining. Mixing and conveying parts shall maintain material at the application temperature. Equipment shall be capable of producing continuous uniformity in dimensions of stripes. Equipment shall be capable of producing various widths of traffic markings.

Glass beads shall be applied to the molten surface of completed stripes by an automatic bead dispenser attached to the striping machine in such manner that beads are dispensed simultaneously with the thermoplastic material at a controlled rate of flow on installed lines. The glass bead dispenser shall be equipped with an automatic cutoff control synchronized with cutoff of thermoplastic material. Kettles to hold a minimum of 1,000 pounds (450 kg) of material shall be provided for melting and heating thermoplastic material. Kettles shall be equipped with automatic temperature control devices so that heating can be done by controlled heat transfer liquid rather than direct flame, to provide positive temperature control and prevent overheating of material.

Applicators and kettles shall be equipped and arranged to comply with requirements of the National Board of Fire underwriters. Applicators shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. Applicator equipment shall consist of a motorized mobile unit capable of installing traffic stripes either left or right of applying unit so that only one lane of traffic will be occupied during installation.

Applicators shall produce sharply defined lines and provide means for cleanly cutting off stripe ends and applying broken lines. The applicator unit shall have a tachometer or other approved device to insure

uniform application at the required rate. It shall be adjustable for applying 1, 2, or 3 adjacent lines simultaneously at the specified spacing. The ribbon extrusion die or shaping die shall not be more than 2 inches (50 mm) above the roadway surface during application.

- (b) Weather Limitations:** Application of markings will not be permitted when there is excessive pavement moisture or when the surface temperature or ambient temperature is below 50°F (10°C). The pavement shall be considered excessively moist when it is visibly wet or when a 1 square foot (0.1 sq m) piece of polyethylene film condenses moisture after being placed on the pavement surface for 15 minutes.

- (c) Cleaning of Surfaces:** Surfaces on which markings are to be applied shall be cleaned of materials that may reduce adhesion of the thermoplastic marking materials to the pavement. Cleaning shall be done by blast cleaning or grinding. Surfaces shall be kept clean until placement of markings.

Existing thermoplastic markings on the roadway that are not flaking or peeling do not require removal prior to placement of new thermoplastic markings. When thermoplastic markings will replace the existing painted markings, the existing painted markings do not require removal prior to applying new thermoplastic markings, provided the existing painted markings are not flaking or peeling. Existing lane line pavement markings on bridges shall be removed prior to applying new markings.

When preformed plastic markings will replace any of the existing markings, the existing markings shall be removed prior to applying the preformed plastic markings.

Removal shall be accomplished by methods which will not damage the pavement or bridge deck. Removal shall be to such extent that 75 percent of the pavement surface or bridge deck under the markings is exposed. At the end of each day's operations, temporary pavement markings complying with DOTD Section 713 shall be placed in areas where existing markings have been removed and new markings not placed. Temporary pavement markings shall be satisfactorily removed prior to resuming plastic striping operations.

- (d) Application of Markings:** Material shall be installed in specified widths from 4 inches to 24 inches (100 mm to 600 mm). Finish lines shall have well defined edges and be free of waviness. Measurements shall be taken as an average through any 36-inch (900 mm) section of line. Longitudinal lines shall be offset approximately 2 inches (50 mm) from longitudinal joints. A tolerance of +1/2 inch and -1/8 inch (+13 mm and -3mm) from the specified width will be allowed, provided the variation is gradual. Segments shall square off at each end without mist or drip. Transverse variations from the control device up to 1 inch (25 mm) will be allowed provided the variation does not increase or decrease at the rate of more than 1/2 inch in 25 feet (15 mm in 10.0 m). Lines not meeting these tolerances shall be removed and replaced at no direct pay.

- (1) Thermoplastic Markings:** Thickness of material, not including drop-on beads, shall be not less than 90 mils (2300 µm) for lane lines, edgelines and gore markings and not less than 125 mils (3200 µm) for crosswalks, stop lines, and word and symbol markings. When striping over existing painted stripe, old bleached asphalt, on all portland cement concrete surfaces, or on all surfaces when ambient temperatures are below 70°F (20°C), a binder sealer shall be used and installed as recommended in writing by the thermoplastic material supplier.

Thermoplastic material shall be applied either by extrusion at 390°F and 450°F (200°C and 230°C) or by spray at 410°F and 450°F (210°C and 230°C). Immediately after application of the markings, glass beads shall be applied at a minimum rate of 300 pounds per mile (85 kg/km). Material shall not scorch or discolor when kept at this temperature range for 4 hours.

- (2) Preformed Plastic Markings:** Plastic material shall be applied by removing release paper and applying adequate pressure to ensure proper adhesion. Material not adhering properly shall be satisfactorily corrected at no direct pay.

(e) Construction Requirements for Inverted Profile Thermoplastic Marking Material:

(1) Equipment: The application equipment shall be specially designed for placing hot thermoplastic material in a hot molten state on the pavement surface utilizing a pressure type application method. The hot thermoplastic line shall be formed by a thermoplastic die that is allowed to drag along in proximity with the road surface. The die is pulled forward by a special linkage that will allow it to automatically level itself as to float and remain parallel with the road surface. The traffic stripe shall be formed by reason that the hot thermoplastic is forced under pressure through four sides of the thermoplastic die onto the road surface. The top of the die shall be closed and provide entry means for the hot molten thermoplastic to enter the die cavity. The bottom of the die shall contain a movable door that is remote-controlled so as to start or stop the flow of thermoplastic onto the pavement surface. When the movable door is open, thermoplastic can flow through the die and will apply a thermoplastic line that will be formed rearward of the advancing die. The road surface shall be at the bottom of the die enclosure. Thermoplastic shall be fed to the die under pressure through flexible oil-jacketed stainless steel hoses. The thermoplastic must be either pumped or fed from a pressure vessel to the die under pressure in order to obtain the proper adhesion with the road surface. The thermoplastic extrusion die shall incorporate within the same housing a special curtain coater, low pressure drop-on type glass bead gun, (bead coat No. 1). The pressure extrusion die and curtain coat bead gun shall be a single unit that is oil-jacketed on four (4) sides and is formed from a single solid block of steel.

This glass bead gun shall dispense glass beads onto the hot thermoplastic line from a height of approximately 1 inch (25 mm) above the road surface. The point at which the glass beads strike the surface of the stripe shall not be more than 2 3/4 inches (70 mm) behind the strike point of the thermoplastic itself. This reflective bead coat No. 1 shall utilize Class A glass beads as specified herein, and shall provide a surface coating of 50 percent of the thermoplastic line surface. Of this 50 percent line coverage, at least 50 percent of the beads will be embedded to a depth of 60 percent of their diameter. This will lock the glass beads into the hot molten thermoplastic stripe. This coating of glass beads will provide the permanent long term reflectance of the line stripe. Care must be taken that the rate of application for bead coat No. 1 to be as specified. Too many beads will cause a rapid cooling of the surface of the stripe which will lead to premature bond failure of the glass beads from the in-place stripe. Too few beads will result in poor initial reflectance readings.

A second curtain coater, low pressure drop-on type glass bead gun capable of applying a continuous sheet or ribbon of glass beads shall follow at an interval of approximately 10 inches (250 mm) behind the first bead gun. This second glass bead gun shall apply bead coat No. 2 which will form a continuous drop-on coat of Class B glass beads immediately in front of the line profiling device. This second curtain coat of glass beads shall have a low impact speed so that they are not forced into the stripe under pressure. A special rotatable wheel line profiling device shall be located approximately 8 inches (200 mm) behind bead gun No. 2. This rotatable wheel device shall be approximately 7 inches (175 mm) in diameter and shall have a plurality of spaced projections located around its circumference. The line profiling device shall be wider than the line stripe being applied in order that the line shall be adequately covered. The projections on the rotatable line profiling device shall have an angular line profiling surface set at an angle to the pavement surface. The rotatable line profile device shall be mounted with an automatic leveling device to the same carriage assembly as the thermoplastic gun. This is required so that a traffic stripe of accurate and uniform line definition can be obtained. Using rollers to place grooves in the traffic stripe utilizing a separate vehicle or grooves that are not pressed within one (1) second of thermoplastic material application will not be allowed under this specification.

It is the intent of this specification that inverted profile grooves be pressed into the hot molten thermoplastic stripe within one (1) second of the thermoplastic application in order to insure proper bead adhesion to the stripe. To insure that no hot thermoplastic adheres to the wheel as it rotates and profiles the stripe, a small air atomizer water jet shall apply a thin mist coat of water to the rotatable profile wheel. It is the intent of this specification that a minimum amount of water be used and that no water puddles greater than 1/4 inch (6 mm) in diameter be allowed to accumulate on the pavement surface in proximity to the freshly placed stripe. Excess water on the pavement surface can cause bond failure of the thermoplastic material. All parts of the thermoplastic holding tank including manifolds, hoses, pipes, dies, etc., shall be oil-jacketed to insure accurate temperature control. The thermoplastic material shall be preheated in kettles designed specifically for that purpose. Each kettle of preheated thermoplastic material shall be properly mixed and heated to the correct application temperature. The preheated material shall then be fed to the thermoplastic gun for application. The striper unit shall contain enough glass beads and water to apply one full kettle of thermoplastic.

- (2) Cleaning of Pavement Surface:** All pavement areas to be striped shall be thoroughly cleaned using equipment capable of cleaning without damaging the surface. This will include, but not be limited to, all vegetation, loose soil, oils, and other debris. Striping shall follow as closely as practical after the surface has been cleaned.
- (3) Application Over Existing Striping:** Where so shown on the plans or directed, the existing traffic line stripe shall be removed by grinding. When placing Inverted Profile Thermoplastic Stripe on existing asphalt pavement that has more than one existing light coat of striping material, the existing stripe shall be removed to the point that 80 percent of the pavement surface is visible. When placing Inverted Profile Thermoplastic Stripe on portland cement concrete, no existing stripe or curing compound shall be striped over. Concrete surfaces shall be ground to the point that 80 percent of the pavement surface is visible. Removal of existing stripe will be paid for as a separate item of work. Where unsatisfactory striping performed by the contractor must be removed and replaced in accordance with these specifications, the contractor shall use the removal method described above. No payment will be made for removal or replacement of the contractor's unsatisfactory striping.
- (4) Surface Conditions:** When placing Inverted Profile Traffic Stripe, no striping shall be permitted when the surface temperature is less than 60°F (16°C). A non contact infrared pyrometer shall be supplied by the contractor for use by the engineer for temperature verification. To prevent the rapid cooling of the freshly placed line, no striping shall be performed when there is moisture on the pavement surface or when winds exceed 12 mph (19km/h). After hard rains, even though no moisture is visible, portland cement concrete surfaces can hold water. When unseen moisture is suspected to be present, a moisture test shall be performed. The test shall be as follows:

 - a. Place a piece of tar paper on the pavement surface.
 - b. Pour 1/2 gallon (2 L) of thermoplastic onto the paper.
 - c. After two (2) minutes, lift the paper and inspect to see if moisture has been drawn from the pavement.
 - d. If moisture is present, do not proceed with striping until the surface is moisture free.

Documentation of weather and pavement conditions shall be maintained by the contractor and supplied to the engineer on the approved City form.
- (5) Application:** The thermoplastic material shall be preheated and thoroughly mixed at an application temperature of between 400°F (200°C) minimum and 430°F (220°C) maximum. A digital thermometer complete with a 24-inch (600 mm) probe shall be supplied by the contractor to the engineer for temperature verification.

When measured at the highest point of the profile, the cold thickness of the in place thermoplastic stripe shall be a minimum of 0.140 inch (4 mm) for Inverted Profile markings. The thickness of the thermoplastic in the bottom of the profiles shall range from .025 - .050 inch (0.65 mm to 1.25 mm). The individual profiles shall be located transversely across the traffic stripe at intervals of approximately 1 inch (25 mm). The bottoms of these intervals shall be between 3/32 and 5/16 inch (2.5 mm and 8 mm) wide. In order to drain water and to reflect light, it is normal for the top surface of the Inverted Profiles to be irregular. The rate of thermoplastic application for Inverted Profile thermoplastic shall be a minimum of 1,800 lb per mile (507 kg/km) for a 4-inch (100 mm) solid traffic stripe.

The glass bead application rate for Class A glass beads (bead coat No. 1) shall be 200 lb per mile (56 kg/km) of 4-inch (100 mm) solid traffic stripe. The glass bead application rate for Class B glass beads (bead coat No. 2) shall be 200 lb per mile (56 kg/km) of 4-inch (100 mm) solid traffic stripe. The thickness of the striping materials shall be verified periodically (at least every 1/4 mile (400 m)) and any thickness more than 5 percent under the designated thickness shall be reworked. A consistent, uncorrected under run will not be allowed and the contractor will be required to install the specified minimum thickness of 0.140 inch (4 mm). A wet thickness gauge and cold thickness gauge shall be supplied by the contractor to the engineer for film thickness verification.

When striping over existing painted stripe, old bleached asphalt, on all portland cement concrete surfaces, or on all surfaces when ambient temperatures are below 70°F (20°C), a two component epoxy primer sealer shall be used and installed as recommended in writing by the thermoplastic material supplier. The epoxy primer sealer shall be EX255/EX256 as manufactured by Crown Paint Company of Oklahoma City, Oklahoma or approved equal. The contractor shall supply certification of compatibility of the primer sealer used with the thermoplastic material applied. If an alternate epoxy primer to the EX255/EX256 is used, the contractor shall supply a mill analysis and proof of adequate performance of the alternate epoxy primer when used with thermoplastic pavement markings.

1303.04 MEASUREMENT.

- (a) Plastic Pavement Striping:** Plastic striping will be measured by the linear foot (lin m) or mile (km), as specified.
 - (1) Linear Foot (Lin m):** Measurement will be made by the linear foot (lin m) of striping, exclusive of gaps.
 - (2) Mile (km):** Measurement will be made by the mile (km) of single stripe. No deduction will be made for standard 30-foot (9 m) design gaps in broken-line striping; however, deductions will be made for the length of other gaps or omitted sections.
- (b) Plastic Pavement Legends and Symbols:** Plastic legends and symbols will be measured per each legend or symbol. Symbols shall include all letters, lines, bars or markings necessary to convey the message at each location.
- (c) Removal of Existing Markings:** Removal of existing markings will be measured by the mile (km) and will include removal of lane lines, edge lines, gore markings, symbols and raised traffic markings for the full roadway and shoulder width.

1303.05 PAYMENT. Payment for plastic pavement markings and removal of existing markings will be made at the contract unit prices under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
I 303-01	Plastic Pavement Striping	Linear Foot
I 303-02	Plastic Pavement Striping (Solid Line) (inch (mm) Width)	Mile
I 303-03	Plastic Pavement Striping (Broken Line) (inch (mm) Width)	Mile
I 303-04	Plastic Pavement Legends and Symbols (Type)	Mile
I 303-05	Removal of Existing Markings	Each

SECTION 1304

PAINTED TRAFFIC STRIPING

1304.0 DESCRIPTION. This work consists of furnishing and applying reflective white or yellow paint for pavement striping in accordance with plan details, the MUTCD and these specifications.

1304.02 MATERIALS. Traffic paint shall be either quick dry alkyd or water based traffic paint complying with Subsection 215.12. Glass beads for drop-on application shall comply with Subsection 215.13.

1304.03 EQUIPMENT. Selection of proper equipment to produce satisfactory results within the following requirements shall be the responsibility of the contractor.

- (a) Equipment shall permit traffic to pass safely within the limits of the roadway surface and shoulder while operating.
- (b) Equipment shall be designed for placement of both solid and broken line stripes of the spacing shown on the plans with square, neat stripe ends.
- (c) Equipment shall provide a method for cleaning the surface of dust immediately prior to placement of striping materials.
- (d) Equipment shall provide for drop-on application of glass beads.
- (e) The equipment shall provide accurate regulation of the application rate and shall have a tachometer or other approved device to ensure uniform paint application at the designated rate. The equipment shall be adjustable for applying one, two or three adjacent lines simultaneously at the specified spacing and be equipped with a device capable of following a control line. Operation of the unit shall be such that paint will not be spattered or blown on another stripe. The unit shall be designed to properly agitate the paint while in operation.
- (f) The equipment shall be equipped with a heat exchanger to heat the paint to reduce drying time.
- (g) The operation shall include a trailing vehicle equipped with a flashing arrow board.

1304.04 SURFACE PREPARATION. Surfaces to be striped shall be cleaned of materials that may reduce adhesion of paint to pavement. Surfaces shall be kept clean and dry at the time of application of paint.

1304.05 WEATHER LIMITATIONS. No paint striping shall be done when the pavement surface is not thoroughly dried, when the air is foggy or misty, when the air or surface temperature is below 50°F (10°C), or when wind or other condition causes a film of dust to be deposited on the surface after cleaning and before striping can be done or causes displacement of striping material.

1304.06 APPLICATION. The longitudinal joint or existing centerline stripe shall be used in determining the location of the centerline of new striping. In the absence of a longitudinal joint or existing stripe, the location of the centerline of new striping shall be located by the contractor with the approval of the engineer. Broken line individual intervals will not be marked. No striping material shall be applied over a guide stringline.

- (a) Paint Preparation: Immediately before application, paints shall be agitated and mixed thoroughly to a uniform consistency, free from lumps or agglomerates. Paints shall be kept covered to retain volatiles. Paints shall not be thinned without approval.
- (b) Application Rate: Paint shall be applied at the rate required to provide striping of the specified width at a thickness of 15 wet mils (380 wet µm).

Glass beads shall be applied at the same time, but in a separate operation, at the rate of $6\pm 1/2$ pounds (0.720 ± 0.060 kg) of beads per gallon (L) of paint. Beads shall be applied to the paint before final set has occurred and accomplished in such manner as to provide uniform coverage of the stripe. Beads shall be applied to the paint immediately after it has been applied to the pavement. Beads shall be applied by compressed air of sufficient pressure to cause embedment of the beads throughout the thickness of the paint. Guns for bead application shall be of an approved type and care shall be taken to prevent loss of beads due to side spray or non-embedment.

Paint shall be heated in heat exchangers to accelerate drying, to a temperature between 110°F and 130°F (43°C and 54°C) for water based paint, and between 120°F and 150°F (49°C and 66°C) of solvent based paint.

1304.07 TOLERANCES. A tolerance of $+1/2$ inch and $-1/8$ inch ($+13$ mm and -3 mm) from the specified width will be allowed, provided the variation is gradual. Segments of broken line may vary ± 6 inches (150 mm) from the specified length provided it is not consistently short. Segments shall be squared off at each end without mist or drip. Longitudinal painted lines shall not deviate from established alignment by more than 1 inch (25 mm) provided the variation does not increase or decrease at the rate of more than $1/2$ inch in 25 feet (15 mm in 10 m). Lines not meeting these tolerances shall be removed by abrasive blasting or grinding and replaced at no direct pay.

1304.08 PROTECTION OF MARKINGS. Traffic shall be prevented from crossing a wet stripe. The contractor shall use flaggers or other methods to prevent traffic from crossing the wet stripe or adjust the operation. Stripes which have been marred or picked up by traffic before they have dried shall be repaired by the contractor at no direct pay. The pavement shall be cleaned outside the stripe at no direct pay. The contractor is not required to maintain striping which has been accepted and opened to traffic.

1304.09 PROTECTION OF TRAFFIC. The contractor shall furnish and place all necessary temporary warning and directional signs to direct and protect the traveling public during striping operations. The pavement striping equipment shall move in the direction of normal traffic flow. The trailing vehicle shall be equipped with an approved flashing arrowboard for directing traffic to the appropriate side during striping operation, when required. Temporary signs, cones and equipment shall be removed from the roadway when striping equipment is not in operation. Protective and traffic marking devices shall comply with DOTD Section 713.

1304.10 MEASUREMENT. Painted Traffic Striping will be measured by the mile (km) or linear foot (lin m) as specified.

- (a) Mile (km): Measurement will be by the mile (km) of single stripe per roadway. No deduction will be made for the standard 30-foot (9 m) design gaps in broken-line striping; however, deductions will be made for the length of other omitted sections.
- (b) Linear Foot (Lin m): Measurement will be by the linear foot (lin m), exclusive of gaps.

1304.11 PAYMENT. Payment for painted traffic striping will be made at the contract unit prices. Payment will be made under:

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
I304-01	Painted Traffic Striping (Solid Line)	Mile
I304-02	Painted Traffic Striping (Broken Line)	Mile
I304-03	Painted Traffic Striping (Solid Line)	Linear Foot

SECTION 1305

RAISED PAVEMENT MARKERS

1305.1 DESCRIPTION. This work consists of furnishing and placing reflectorized and non-reflectorized raised pavement markers at the locations shown on the plans or as directed, and in conformance with the plan details and these specifications.

1305.2 MATERIALS.

1305.2.1 Markers. Markers shall conform to Subsection 209.7.2. The same product shall be used throughout the project. Any changes in design or materials of a previously approved product will require requalification by the City prior to use. Markers will be reflectorized, as specified, and shall be of the class, type, color, size and shape required by the plans or project specifications.

1305.2.2 Adhesive. The adhesive used for placing raised marker on the roadway surface shall be a two-component epoxy adhesive conforming to Subsection 209.7.2.4. The two components shall be mixed in equal parts by volume. Mixing and dispensing of adhesive shall be done by mechanical methods, unless hand methods are permitted by the Engineer.

1305.3 CONSTRUCTION REQUIREMENTS.

1305.3.1 Weather Limitations. Application of markers will not be permitted when there is moisture on the pavement surface. If a normal set type of adhesive is used, application of markers will not be permitted at ambient air temperatures less than 50 degrees F (10 degrees C). If a rapid set type of adhesive is used, application of markers will be permitted at ambient air temperatures between 35 degrees F and 50 degrees F (2 degrees C and 10 degrees C), provided the adhesive is adequately heated to obtain proper viscosity for mixing and application, and provided the adhesive is identified as a rapid set type on the container labels and the certificates of delivery.

1305.3.2 Cleaning of Pavement Surfaces. Pavement surfaces on which markers are to be applied shall be cleaned of all dirt, grease, oil, striping, curing compound, loose or unsound layers, and any other material that would reduce the bond of the adhesive. The surfaces shall be cleaned by blast cleaning or other approved methods; however, when blast cleaning methods are used on asphaltic surfaces, the blast cleaning equipment must be provided with positive cutoff controls and the cleaning operations shall be performed by approved methods that satisfactorily clean the surface without damaging the pavement. Pavement surfaces shall be maintained in a clean condition until placement of the markers.

1305.3.3 Application of Markers. Pavement surfaces shall be blown dry immediately prior to marker placement. Markers shall be applied to the pavement surfaces with adhesive in accordance with the manufacturer's recommendations. The adhesive bed area shall be equal to the bottom area of the marker, and adhesive shall be applied in sufficient quantity to cause excess to be forced out around the entire perimeter of the marker. Voids in markers with an open grid pattern on bottom shall be filled with adhesive during placement.

The mixed adhesive shall have a uniformly gray color with no visible evidence of streaks of either black or white on the surface or within the mixed adhesive. Voids in a cured undisturbed sample approximately 1/16 inch (1.58 mm) thick

from the extrusion nozzle shall not exceed 4 percent by volume. Machine mixer and applicator must be capable of accurately and uniformly proportioning the two components in a ratio of 1 to 1 within $\pm$ percent by volume of each component (i.e. within range of 47.5 to 52.5 percent for each compound). Periodic checks of the proportioning equipment shall be made to determine the actual ratio of components. This shall be done by containers placed before the mixing chamber and the actual volume of each component measured. The equipment shall be arranged so it is possible to bypass the mixer in order to perform these periodic checks. The temperature of the adhesive shall be maintained at 70 degrees F to 110 degrees F (21 degrees C to 43 degrees C) before mixing, with this premix temperature adjusted such that there shall no excessive flow of epoxy from the marker when installed.

1305.4 METHOD OF MEASUREMENT. Raised pavement markers will be measured by counting the number of markers furnished, placed and accepted.

1305.5 BASIS OF PAYMENT. The accepted quantity of raised pavement markers will be paid for at the contract unit price per each.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
1305(1)	Nonreflectorized Raised Pavement Markers (Class I)	Each
1305(2)	Reflectorized Raised Pavement Markers (Class IV)	Each
1101(3)	Ceramic Raised Pavement Markers	Each

SECTION 1306

TEMPORARY SIGNS, BARRICADES, BARRIERS AND PAVEMENT MARKINGS

1306.01 DESCRIPTION. This work consists of furnishing, installing, maintaining, and removing temporary construction barricades, precast concrete barriers, lights, signals, pavement markings and signs; providing flaggers; and complying with all other requirements regarding the protection of the work, workers and safety of the public. Signs, barricades, barriers, channelizing devices, pavement markings, etc., shall comply with plan details, the MUTCD and these specifications.

Signs, barricades, barriers, channelizing devices, pavement markings and arrangements thereof, as shown on the plans, are minimum requirements. Appropriate signs for special conditions shall be furnished and installed as directed. Requirements for proper signs, barricades, barriers, channelizing devices, or other safety precautions promulgated by the contractor's insurers are not negated by these specifications. These specifications shall not be construed to relieve the contractor of responsibilities for the safety of the public, for liability in connection therewith, or compliance with State and local laws or ordinances.

1306.02 MATERIALS. Materials for temporary signs, barricades, barriers and related devices shall comply with the following Subsections:

- (a) Temporary Pavement Markings:** Temporary pavement markings shall be a minimum of 4 inches (100 mm) wide.
- (b) Reflective Sheeting:** Reflective sheeting requirements for temporary signs, barricades, channelizing devices, drums and cones shall comply with the following:
 - (1) Temporary Signs and Barricades:** On the mainline of interstate highways, reflective sheeting for the first four temporary advanced warning signs shall comply with the requirements of DOTD Type VII (Fluorescent Orange). Reflective sheeting for all other temporary signs and barricades on the National Highway System (NHS) shall comply with the requirements of ASTM D 4956, Type III. On all other highways not part of the NHS, reflective sheeting for all temporary signs and barricades shall comply with the requirements of ASTM D 4956, Type III.
 - (2) Vertical Panels:** Reflective sheeting for vertical panels used to channelize or divide traffic shall meet the requirements of ASTM D 4956, Type III.
 - (3) Drums:** Reflective sheeting for drums shall be a minimum of 6 inches (150 mm) wide and shall meet the requirements of ASTM D 4956, Type III, and the Supplementary Requirement S2 for Reboundable Sheeting as specified in Subsection 1015.05 of the LA DOTD Specifications.
 - (4) Cone Collars:** Reflective sheeting for traffic cone collars shall meet the requirements of ASTM D 4956, Type VI.

1306.03 FABRICATION. Fabrication of temporary signs, barricades and related devices shall conform to Subsection 729.04 of the LA DOTD Specifications. Fabrication of precast concrete barriers shall conform to Section 805 of the LA DOTD Specifications.

1306.04 TEMPORARY SIGNS AND BARRICADES.

- (a) General:** Signs, barricades and related devices will be required when the contractor's work is in progress on portions of the work covered by the Notice to Proceed, or when operations are suspended but the

traveled portion of the road is not in a safe condition for the traveling public. During such times that barricades are not in place, appropriate regulatory signs shall be erected and maintained by the contractor. If a partial Notice to Proceed is issued, the contractor shall immediately begin erection of signs and barricades over the affected portions of the project to the extent necessary to comply with the requirements herein. When the full Notice to Proceed is issued, barricades shall be erected at the beginning and end of the project. Signing throughout the remainder of the project shall be completed.

Construction work shall not begin until signs, barricades and other traffic control devices have been erected and approved. When signs to be furnished and erected by the contractor are in place and approved, the Department's forces will remove or cover any standard signs that are in conflict with temporary signs. When placing signs, the contractor shall cooperate with the engineer as well as the Department's forces responsible for removing Departmental signs, so that appropriate signs are in place at all times.

Signing shall remain in place and be maintained by the contractor, supplemented by additional signs as required, throughout the life of the contract. When previously used signs are to be erected on a project, the engineer will inspect and approve these signs before erection. The engineer will require any sign with reduced reflectivity or excessive color fading to be removed from the work zone. In case of a dispute over a rejected used sign, the Department at its discretion, may take such measurements or review reflectivity and color data obtained by the contractor to determine if the sign meets minimum standards for new materials. Signs that do not meet the minimum standards for new materials shall be replaced by the contractor at no direct pay.

Rejected signs will be marked "NOT FOR USE ON STATE PROJECTS", and the date and stamp will be obliterated. Signs placed by the contractor shall not be removed until the contract is completed and the Department's forces have erected permanent highway signs along the project. It will be the responsibility of the Department to see that all permanent highway signs are in place upon completion and acceptance of the project.

On projects where the surface course is constructed with asphaltic concrete or portland cement concrete, permanent striping and raised pavement markers (when required) shall be completed prior to removal of barricades. Signs, barricades and related devices furnished and placed by the contractor shall, upon removal, remain the contractor's property.

- (b) **Advance Warning Area:** When specified, advance warning arrow panels for temporary traffic control shall be provided at locations shown on the plans or as directed. Panels shall be one of the specified types complying with the Department's MUTCD. If no type is specified, Type C panels shall be furnished.
- (c) **Construction Zone:** In areas of the construction zone where construction or maintenance work has degraded the condition of the original highway, where work is in progress in the immediate vicinity of the travel-way, or where workers are in close proximity to traffic, a reduced speed limit of 10 mph less than the pre-existing speed limit will be used. Speed limits should be further reduced if the engineer determines that geometrics or work conditions warrant a reduction. Pre-existing speed limits of 35 mph or less generally do not warrant further reduction.

When SPEED ZONE AHEAD signs are required in the plans, supplemental signs with the legend HIGHER / TRAFFIC / FINES IN / WORK / ZONES signs shall also be required. These signs shall be black legend on white background and shall be 36 inches (900 mm) wide by 48 inches (1200 mm) tall for interstate applications and 24 inches (600 mm) wide by 30 inches (750 mm) tall for non-interstate applications. The signs shall be included in the Temporary Signs and Barricades pay item at no additional cost.

1306.05 TEMPORARY PRECAST CONCRETE BARRIERS. Barrier units will be furnished by the contractor unless specified otherwise. Each barrier unit shall be 15-feet (4.6 m) in length. When the barrier units are furnished by the City the units will be furnished at no cost to the contractor. The contractor shall load the barrier units at the

location specified, deliver the units to the construction site and place them as required.

The contractor shall relocate barrier units as required during construction at no direct pay. Connecting pins and plastic reflectors shall be furnished by the contractor at no additional cost to the City. Reflectors shall have 7.0 square inches (4500 sq mm) minimum reflective area, and be installed a maximum of 15 feet (4.6 m) apart (each side) in accordance with the manufacturer's recommendations. Damaged pins or reflectors shall be replaced as directed by the engineer.

After completion of the work, barrier units shall become the property of the City and shall be removed and transported by the contractor to the location specified and unloaded as directed. All costs of loading, transporting and unloading the barrier units shall be included in the price bid on this item. Barrier units damaged shall be satisfactorily repaired or replaced at no direct pay.

1306.06 PAVEMENT MARKINGS. Color, width and type of temporary pavement markings shall be in accordance with Table 1306-I and the MUTCD. Temporary pavement markings shall be in place at the end of each day's operation. Temporary striping tape shall be applied by approved methods to the satisfaction of the engineer. Thermoplastic Pavement Markings shall be applied in accordance with Subsection 1303. Painted Traffic Striping shall be applied in accordance with Section 1304.

Table 1306-I
Temporary Pavement Markings ¹

		Two-lane Highways	Undivided Multilane Highways	Divided Multilane Highways
S H O R T	ADT<1500; or ADT>1500 and time<3 days	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers; with "Do Not Pass" and "Pass With Care" signs as required	N/A	N/A
	ADT>1500; Time>3 days and<2 weeks	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers with no passing zone markings	N/A	N/A
L O N G T E R M	All ADT's with time <2 weeks	N/A	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers; double yellow centerline	Lane lines 4-foot (1.2 m) tape on 40-foot (12 m) centers
	All ADT's with time >2 weeks	Standard lane lines, no-passing zone markings, legends and symbols and when pavement width is 22 feet (6.7 m) or greater, edge lines	Standard lane lines, centerlines, edge lines, and legends and symbols	Standard lane lines, centerlines, edge lines, and legends and symbols.

¹ No passing zones shall be delineated as indicated whenever a project is open to traffic.

- (a) **Short-term Pavement Markings:** Short-term pavement markings will be required on any pavement surface under traffic. Center lines on two-lane highways and lane lines on multilane highways shall be temporary striping tape a minimum of 4 feet (1.2 m) long on a maximum of 40-foot (12 m) centers. When short-term pavement markings require no-passing zone markings or double yellow center lines on undivided multilane highways, they shall be any of the temporary pavement markings listed in Subsection 1306.02. Removal of short-term pavement markings will only be required on the final surface.
- (b) **Long-term Pavement Markings:** Long-term pavement markings will be required on any surface which is not covered by an additional surface in 2 weeks or less. Long-term pavement markings shall include, but are not limited to, standard lane and centerline markings (i.e., 10-foot (3 m) stripes on a maximum of 40-foot (12 m) centers), edge lines, no passing zone markings on 2-lane highways, stop bars, and legend and symbol markings as shown on the permanent pavement marking details. Layout work for exact location of markings will only be required on the final surface. These markings shall consist of any of the pavement markings listed in Subsection 1306.02. Long-term markings do not include the installation of raised pavement markings.
- (c) **Final Surface:** On the final surface (portland cement concrete pavement or asphaltic concrete pavement), temporary markings shall be placed with sufficient accuracy to avoid conflict with permanent striping where possible. Temporary pavement markings on the final surface shall be any of the pavement markings listed in Subsection 1306.02.
- Placing permanent markings over traffic paint will be acceptable on final surfaces provided the temporary markings have been placed in the final configuration (proper final layout) and the painted lines are not flaking or showing signs of deterioration.
- The removal of temporary pavement markings, if required, shall be in accordance with the requirements for the type of permanent marking being used. There shall be no objectionable staining of pavement surface as a result of the removal procedure.
- (d) **Temporary Reflectorized Raised Pavement Markings:** When required, temporary reflectorized raised pavement markings shall be installed in accordance with Section 1305.

1306.07 MEASUREMENT.

- (a) **Temporary Signs and Barricades:** When the contract does not include a pay item for "Temporary Signs and Barricades," the providing of temporary construction signs, barricades and related devices will not be measured for payment. When a pay item for "Temporary Signs and Barricades" is included in the contract, the furnishing, erecting, maintaining and subsequent removing of temporary construction signs, barricades and related devices will be measured on a lump sum basis.
- (b) **Temporary Pavement Markings:** When the contract does not include an item for "Temporary Pavement Markings," the providing of these markings will not be measured for payment. When the contract includes an item for "Temporary Pavement Markings", these markings acceptably furnished, placed, maintained and subsequently removed will be measured on a lump sum basis, or by the linear foot (lin m), or by the mile (km) as specified. When measurement is made by the linear foot (lin m) of striping, gaps will not be measured.
- When measurement is made by the mile (km) of single strip per roadway per application, no deduction will be made for the standard design gaps in broken line striping; however, deductions will be made for the length of other gaps or omitted sections.
- Temporary pavement legends and symbols will be measured per each legend or symbol. Temporary reflectorized raised pavement markers will be measured by counting the number of markers furnished,

placed and accepted. Removal of raised pavement markers will be at no direct pay.

Advance warning arrow panels will not be measured for separate payment, but will be included in the contract lump sum price for Temporary Signs and Barricades.

(c) Temporary Precast Concrete Barriers: Temporary precast concrete barriers will be measured per each unit.

1306.08 PAYMENT. Payment for temporary construction signs, barricades and related devices will be at the contract lump sum price in accordance with the payment schedule of Table 1306-2.

Table 1306-2
Payment Schedule
Temporary Signs, Barricades and Related Devices

Percent of Total Contract Amount Earned	Allowable Percent of Lump Sum Price for Temporary Signs and Barricades
Initial Erection	20
25	40
50	40
75	80
100	100

Payment for temporary pavement markings will be made at the respective contract unit prices. Payment for temporary precast concrete barriers will be made at the contract unit price per each. The concrete in temporary precast barriers furnished by the contractor will be identified by lots and shall be subject to pay adjustments in accordance with DOTD Table 901-3 and Note 3 therein. Size, sampling, and testing of each concrete lot shall be in accordance with the Materials Sampling Manual. Payment will be made under:

<u>Item No</u>	<u>Pay Item</u>	<u>Pay Unit</u>
I306-01	Temporary Signs and Barricades	Lump Sum
I306-02	Temporary Pavement Markings	Lump Sum
I306-03	Temporary Pavement Markings	Liner Foot
I306-04	Temporary Pavement Markings	Mile
I306-05	Temporary Pavement Markings	Mile
I306-06	Temporary Pavement Legends and	Each
I306-07	Temporary Reflectorized Raised	Each
I306-08	Temporary Precast Concrete Barrier	Each
I306-09	Temporary Precast Concrete Barrier	Each

SECTION 1307

STREET LIGHTING

1307.1 DESCRIPTION. The work shall consist of furnishing and installing, modifying or removing one or more mast are and pole assemblies, all as shown on the plans and as specified in these specifications and the project specifications. Any deviation from the contract documents shall be approved by the Engineer. All materials furnished and used shall be new, except materials specified to be reused.

All incidental parts which are not shown on the plans, or specified herein or in the project specifications, and which are necessary to complete or modify the existing systems, shall be furnished and installed as though such parts were shown on the plans or specified herein. All systems shall be in satisfactory operation at the time of completion of the work.

1307.2 CODES, PERMITS AND INSPECTIONS. All materials furnished and all work performed shall be in accordance with the latest revisions of the National Electrical Code, the National Electrical Safety Code, the requirements of the local power and telephone companies, and the codes, regulations, and rules prevailing in the area in which the work is being performed, insofar as they apply.

1307.3 EQUIPMENT LIST AND DRAWINGS. Unless otherwise authorized in writing by the Engineer, the contractor shall, within 10 days following execution of the contract, submit to the engineer for approval a list of equipment and materials which it proposes to install. The list shall be complete as to name of manufacturer, size and identifying number of each item.

1307.4 MATERIALS. Materials shall conform to Subsection 207.9, project specifications, plans and the following general requirements. All materials shall be of the best quality and workmanship and shall be new and of the most advanced proven design available. Throughout the project all units of any one item shall be made by the same manufacturer, but not all the items are required to be made by the same manufacturer. The above items are mast arms, shaft, shaft base, handholds, anchor bolts, and conduits.

1307.5 WARRANTIES, GUARANTEES AND INSTRUCTION SHEETS. Manufacturer's warranties and guarantees shall be furnished for materials used in the work along instruction sheets and parts lists, prior to acceptance of the project. The duration of the warranty or guarantee shall be the standard of the industry with a minimum of one year from the date of acceptance of the work.

1307.6 CONSTRUCTION GENERAL.

1307.6.1 Excavation and Backfill. The excavation required for the installation of conduit, foundations and other equipment shall be performed in such a manner as to cause the least possible damage to the streets, sidewalks and other improvements. The trenches shall not be excavated wider than necessary for proper installation of the electrical equipment or foundations. Excavating shall not be performed until just prior to installation of equipment. The material from the excavation shall be placed in a location to cause the least obstruction to surface drainage and vehicular and pedestrian traffic.

Where excavations are required in lawns, existing sod shall be removed and preserved by the contractor. After backfilling, the sod shall be replaced. After backfilling, excavations shall be kept well filled and maintained in a smooth

and well-drained condition until permanent repairs are completed.

1201.6.2 Foundations. Concrete for foundations shall be Class A in accordance with Subsection 201.1. Where forms are required because of soil conditions or grade, they shall be true to line and grade, firmly braced and secured in place, and shall not be removed until the concrete has set. Foundations shall cure for 24 hours before erecting standards and 72 hours before erecting arms. Pile foundations shall cure for 48 hours before erecting standards and 7 days before erecting arms.

1307.6.3 Shafts and Shaft Bases. Plumbing of shafts shall be accomplished by adjusting the nuts on the anchor bolts before the foundation cap is placed. Shims or other similar devices for plumbing or raking will not be permitted. After plumbing the shaft, anchor bolts shall be cut off 1/4 inch (6 mm) above the nuts.

1307.6.4 Pull Boxes and Handholds. Pull boxes and handholds shall be installed at the locations shown on the plans or, in long runs, they shall be spaced at not over 200 feet (61 m). It shall be the option of the contractor, at its expense and subject to the approval of the Engineer, to install additional pull boxes that it may desire to facilitate the work.

1307.6.5 Conduit. All conduits above ground or exposed on structures shall be rigid aluminum. Fittings and covers shall be cast aluminum, and covers shall be sealed with neoprene gaskets. Hardware shall be stainless steel.

Underground conduits shall be galvanized rigid steel, or PVC plastic pipe conforming to ASTM Designation: D 1785. All conduits for buildings shall be galvanized rigid steel, or rigid aluminum or galvanized or aluminum electric metallic tubing. Electrical metallic tubing shall not be placed in the slab, underground, in moist areas or other hazardous locations. Fittings and covers for steel conduits shall be cast or malleable iron with neoprene gaskets.

All conduits entering disconnects, starters and panel boards shall have union hubs or bolt-on hubs. All conduits entering standards, equipment, etc., shall have insulated grounding bushings except where bolted hubs are used. All bushings shall be installed prior to pulling wire. Each circuit shall be run into the controller in a separate conduit.

Conduit on the service poles shall be clamped at approximately 5 foot (1.5 m) intervals with heavy duty galvanized 2-hole pipe clamps and stainless steel lag bolts with flat washers, except when channels or "z" bars are used for mounting.

Cut threads on steel conduit shall be given an approved protective coating before assembly and joints shall be made up tight. Aluminum conduit joints shall be treated with an oxide inhibiting compound before assembly and made up tight.

The maximum length of conduits run between pull points shall not exceed 100 feet (30 m). One-eighth inch (3.17 mm) diameter drain holes shall be drilled at all low points of all surface conduit runs, including expansion joints, before pulling conductors.

1307.6.6 Grounding. The entire system shall be grounded and bonded in accordance with the NEC. All equipment shall be grounded. All ground wire for service poles shall be a minimum AWG No. 6, bare, solid, soft drawn copper, attached to a 5/8 inch (15.87 mm) nominal (1/2 inch minimum 12.7 mm) diameter copperweld steel 10-foot (3.1 m) long ground rod with a bronze clamp.

1307.6.7 Mast Arms. All assemblies shall be installed plumb or level, as applicable, shall be symmetrically arranged, and securely tightened. Construction shall be such that all conductors are concealed within standards or pipe

assemblies. Unless otherwise specified herein or on the plans, heads shall be installed with terminal compartment mountings. For top mounting of a one-way head and mast arm mountings, a slip-fitter without a terminal compartment shall be used.

Clamp-type mounting may be used for installation of heads on existing concrete standards if inserts for terminal compartment mounting have not been provided. The terminal compartment shall be mounted on the standard on the side away from traffic and parallel with the prolongation of the nearest curb face.

I307.7 METHOD OF MEASUREMENT AND BASIS OF PAYMENT. The method of measurement and basis of payment for the mast arm pole assemblies will be made in accordance with the project specifications, and payment will include furnishing all hardware, fittings and incidental parts that are obviously necessary for a complete installation.

SECTION 2000

GRAVITY SEWER MAINS

2000.1 GENERAL. In accordance with the requirements of these Specifications, the Contractor shall furnish and install materials and perform work necessary for or incidental to constructing a sanitary sewer piping system for the gravity sewers complete, flushed, cleaned and ready for use by the Owner.

2000.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. All publications are of most recent version unless otherwise noted.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron, Centrifugally Cast

ASTM INTERNATIONAL (ASTM)

ASTM A674	Standard Practice for Polyethylene Encasement for Ductile Iron Piping for Water and other Liquids
ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C150	Standard Specification for Portland Cement
ASTM C361	Reinforced Concrete Low-Head Pressure Pipe
ASTM C425	Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C942	Standard Test Methods for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C969	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM D448	Standard Classification for Sizes of Aggregates for Road and Bridge Construction

ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds
ASTM D2412	Standard Test Methods for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3350	Polyethylene Plastics pipe and Fittings Materials
ASTM D5260	Standard Classification for Chemical Resistance of Poly (Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chloride Poly (Vinyl Chloride) (CPVC) Compounds
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Poly(Vinyl Chloride) PVC Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	Polyethylene (PE) Plastic Pipe (DR-R) Based on Outside Diameter
ASTM F794	Poly(Vinyl-Chloride) (PVC) Profile Gravity sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F1417	Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
ASTM F2620	Heat Fusion Joining of Polyethylene Pipe and Fittings

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UNI-BELL UNI-B-9	Recommended Performance Specifications for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Diameters 4 through 48 inches).

2000.3 CONSTRUCTION.

2000.3.1 Inspection. All pipe and materials are subject to inspection and approval at the manufacturer's plant, or at the job site, at the discretion of the Engineer. During the unloading process, all

pipe and materials shall be inspected by the Engineer or authorized representative. Defective pipe and material will be rejected for use and the Contractor must immediately remove the same from the job site at no expense to the project. Inspection of pipeline material at the manufacturer's plant or at the point of delivery shall not relieve the Contractor of his responsibility to furnish and install good quality materials.

Material shall be subject to inspection and rejection, at all times, up to and including final acceptance of the completed project. All pipes shall conform to all tests and procedures in Section 2300.

2000.3.2 Material Handling. In loading, unloading, hauling, distributing and laying pipeline materials, the Contractor shall handle the material with the utmost care and in a manner to prevent damage to the pipe. All piping and piping appurtenances shall be stored and stacked per the manufacturer's recommendations. The interior surface of the pipe shall be kept free of dirt and foreign matters at all times. All materials found to have flaws, cracks or other defects (including ultraviolet degradation), whether before or after installation, will be rejected and will be repaired or replaced by the Contractor as directed by the City, at no additional cost. Unless written permission is given by the Engineer, the pipe shall not be strung more than what can be accomplished in one day.

2000.3.3 Location, Alignment and Grade. All gravity sewer lines shall be constructed to give mean velocities, when flowing full, of not less than 2 fps. The following are the minimum and maximum slopes that shall be provided:

Minimum and Maximum Slope for Sewer		
<u>Sewer Size (Inch)</u>	<u>Minimum Slope (%)</u>	<u>Maximum Slope (%)</u>
8	0.40	8.34
10	0.28	6.20
12	0.22	4.86
14	0.17	4.0
15	0.15	3.61
16	0.14	3.31
18	0.12	2.83
21	0.10	2.30
24	0.08	1.93
27	0.067	1.65
30	0.058	1.43
36	0.046	1.12

Slopes less than the above indicated must be pre-approved by the Engineer. The maximum slope shall be such that the velocity in the pipe is limited to 10 feet per second. The Contractor shall install pipe, fittings and structures exactly to the lines, grades and locations shown on the plans. No deviation from the plans will be allowed, unless approved by the Engineer.

When known, underground utilities, pipelines, conduits, structures, and other items near the proposed sewer line will be shown on the plans at approximate locations. The Contractor is responsible for verifying the exact locations (lines and depths), of the underground objects shown on the plans and for maintaining minimum clearances as per applicable standards of the utility companies and government agencies.

Any damage to any pipeline, conduit, or underground utility shall be reported at once to the owner of the utility. The utility owner shall determine how and when repairs will be made and who will make them. If so directed by the utility owner, the Contractor shall effect immediate repairs under the direction or supervision of the owner. All repairs will be at Contractor's expense.

Wherever existing utility structures or branch connections leading to main sewer, drains, or other conduits, pipe or structures, interfere with the grade and/or alignment of the pipe, they shall be permanently supported, relocated or reconstructed by the Contractor working under the supervision and direction of the owner of the utility or obstruction involved.

2000.3.4 Sheeting and Bracing. The Contractor shall install trench sheeting and/or bracing per OSHA requirements. See "Trench Safety Systems" (Section 1004). All sheeting and bracing, which the Engineer directs the Contractor to leave in place, shall be paid at the unit price as set forth in the proposal.

2000.3.5 Laying the Pipe. The Contractor is required to have the pipe manufacturer's technical representative present on the construction site for the first three (3) days of pipe installation so that he/she can render technical advice and assistance, as needed. The Contractor may have this requirement waived, provided he/she submits written documents verifying that his pipe laying foreman and at least two crew members are duly trained and certified by the manufacturer as being qualified to install the type and size of pipe. Otherwise, the Contractor must provide documented evidence that his/her pipe crew has experience laying the same type and size of pipe on at least five other projects in the past two years. Handling and installation shall be in strict compliance with manufacturer's specifications and recommendations.

Special care shall be taken to lay gravity sewer pipe to the exact grade and alignment as called for on the plans. The trench bed shall be as provided in the excavation Section 1002 and as shown in STANDARD PLAN 2000-I. Care shall be taken not to excavate below the depths indicated on the drawings. Excavations exceeding planned depths shall be backfilled with granular fill and compacted to the density of the undisturbed subgrade to return the trench to required depths at no additional cost to the City. When the Engineer requires the trench to be over-excavated because of unsuitable soil materials or excessive water, the Contractor shall over-excavate to the required width or depth, install additional geotextile fabric, install and compact foundation fill material to return the trench to required depths as shown in STANDARD PLAN 2000-I. Foundation fill material shall be ASTM No. 57 stone. These requirements for over-excavation and backfill supersede the requirements for additional excavation specified in Section 1002 Excavation and Backfill.

All pipe, when jointed in the trench, shall permit a smooth flow of water without pooling or settling in low spots. Pipe shall not be cut except for closures. Pipes not making a good fit shall be removed. The interior surfaces of all pipes must be kept clean and free of debris. The interior surfaces of pipe sockets and the exterior surfaces of pipe spigots shall be both clean and dry when the pipe is laid and the joint packed and filled. While pipe laying is in progress, no more than the daily pipe laying production shall be strung out ahead of the jointing crew at any one time. The pipe laying crew shall exercise great care not to disturb the joined pipe so that it remains on line and grade when the laying operation is completed.

The Contractor shall install wyes as shown on the plans and/or as necessary to tie-in all service lines that are already connected to the old sewer system. The Contractor shall physically check and inventory the old sewer line to verify the exact number of wye joints that he needs to buy and install, in order to tie-in all existing service lines. Wyes shall be laid so that the top of the bell of the wye branch and the top of the bell of the main pipe shall be exactly level. (See STANDARD PLAN 2200-10). Wye branches shall be carefully and tightly plugged using only PVC wye caps. No other material shall be used without prior approval by the Engineer.

HDPE pipe laying requirements shall be as required for pipe bursting or horizontal directional drilling requirements as specified by the Engineer.

2000.3.6 Service Laterals & Tie-in Connections. Procedures for sewer service replacement shall be adhered to for the installation of service laterals or stub outs and service lines. Service Laterals are those sections of sewer lines that run from the sewer main to the property line or the easement line. Service lines are those sections of sewer lines that run from the property line or easement line into a home or building. The service laterals or stub outs shall be constructed by the Contractor utilizing standard factory manufactured fittings that are compatible with the sewer main being installed. New service laterals shall extend to the property line, to the easement line in alleys, to the back of curb in streets, or as directed by the Engineer. Service laterals shall also conform to the requirement of City Ordinance. Reconnections of existing service laterals to new sewer mains shall include new pipe, fittings and adapters from the new wye to the existing service lateral or service line installed in accordance with the applicable requirements of

STANDARD PLAN 2200-10.

The Contractor shall vertically adjust the service laterals, as necessary to connect to the existing service lines at the property line or the easement, as applicable. The fittings used for vertical adjustment shall consist of a maximum bend of 45 degrees. The Contractor shall properly position the wyes horizontally in the sewer main so they exactly match up horizontally with the existing in-coming service line and thereby avoid the need for any horizontal adjustment at the service line tie-in point. New service laterals to properties shall include a cleanout at the property line as shown in STANDARD PLAN No 2200-10. The cleanout pipe shall be the same material as the service connection line. The cleanout pipe shall be extended up to terminate at the finished grade with a concrete slab with a frame and cover. The cleanout pipe shall be plugged with an expandable plastic plug.

Service lines severed during construction shall be replaced and repaired immediately by the Contractor. If disruption of community sewer services is deemed critical by the Engineer, the Department of Water and Sewerage shall repair the service lines at the expense of the Contractor. All building service lines encountered during construction shall be adjusted and/or replaced by the Contractor, as required for their connection to the service lateral. All new services shall be installed at a minimum of one (1%) percent slope, or as approved by the Engineer. Connection of new service to the existing sewer service line shall be made with an Inserta-Tee connection or approved equal. Installation shall be in accordance with manufacturer's recommendations.

The Contractor shall be responsible for coordinating the scheduling of tapping crews with building owners and the Engineer, in order that the work is performed in an expeditious manner.

2000.3.7 Cleaning and Testing. Prior to leakage testing, the Contractor shall clean the installed gravity sewer, per Section 2900, of any dirt, sand, debris, grease, etc., and shall flush the installed pipe with water. The cleaned gravity sewer shall then be inspected using Closed Circuit Television (CCTV), by the Contractor, in the presence of a City Inspector. The Contractor shall repeat the cleaning and flushing process, at no cost to the City, until approved by the City Inspector. Contractor shall conduct leakage testing and deflection testing, upon completion of cleaning operations, as specified in Section 2300.

2000.4 MEASUREMENT AND BASIS OF PAYMENT. Measurement of work for payment of sewer line installation shall be by the actual linear footage installed, in the various sizes and depth categories required, as specified and as shown on the Drawings. Linear footage of gravity sewer pipe installed will be measured horizontally from center to center of manholes. The depth shall be calculated from elevations taken approximately fifty (50) feet apart on the ground surface or pavement before it is disturbed, and from the elevations of the invert of the sewer directly below. Pipe installed at the exact depth of the shallow or deep limit of a depth category will be measured for payment at the unit price for the deeper category.

Gravity sewer main installed will be paid for at the contract unit price according to the various sizes, types, and depths. Payment shall include excavation, hauling and disposal of excavated materials, furnishing and installing gravity sewer mains as specified in this section and shown on STANDARD PLANS 2000-1. Payments shall include disconnecting and reconnecting existing service laterals and service lines up to 6 inches in diameter within 5 feet perpendicular to the centerline of the new sewer mains. Payment shall constitute full compensation for furnishing, hauling, trenching, bed preparation, laying, jointing, standard bedding and backfilling the pipe and fittings complete in place, and for furnishing all equipment, tools, labor and incidentals (including cleaning and testing) necessary to complete the item in accordance with the plans and specifications.

Payment for reconnecting existing service laterals and service lines more than 5 feet from the centerline of the new sewer main will be made on a linear foot basis. Measurement will be made perpendicular from the new sewer main centerline to the end of the existing service lateral or service line. Payment shall include pipe up to 6 inches in diameter, fittings, couplings, adapters, excavation, shoring, bedding and backfill complete in place.

Over-Excavation and Backfill will be measured for payment by the maximum trench width shown on STANDARD PLAN 2000-1 (or the width required by the Engineer), the variable depth of foundation fill shown on STANDARD PLAN 2000-1, and the length of the excavation along the centerline of the sewer main. Payment shall include excavation, subgrade preparation, backfilling and compacting foundation fill material.

Payment for new service laterals will be made for each service from the wye to the cleanout as shown in STANDARD PLAN 2200-10 or from the tap in existing sewer mains to the cleanout. Payment shall include tapping existing sewer mains, pipe and fittings up to 6 inches in diameter, excavation, shoring, concrete support, bedding and backfill complete in place.

No direct payment will be made for sheeting and bracing (except extra sheeting and bracing left in place and paid for under other items), dewatering, sump pumping, cleaning and testing.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2000(1)	Gravity Sewer Main (Diameter, Type, Depth Category)	Linear Foot (LF)
2000(2)	Additional Length of Service Lateral	Linear Foot (LF)
2000(3)	New Service Lateral (Short Side)	Each (EA)
2000(4)	Over-Excavation and Backfill	Cubic Yard (CY)
2000(5)	New Service Lateral (Long Side)	Each (EA)

SECTION 2100

SEWER FORCE MAINS

2100.1 GENERAL. This section specifies the construction standards to be met for assembling and installing sanitary sewer force mains. It details the labor, equipment and incidentals required to install force main pipe, fittings, and appurtenances complete, as shown on the plans and as specified in this section.

2100.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only and the most recent edition shall be used.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron, Centrifugally Cast
AWWA C153	Ductile-Iron Compact Fittings for Water Service
AWWA C900	PVC Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm)
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,575 mm), for Water Distribution and Transmission

ASTM INTERNATIONAL (ASTM)

ASTM A242	High-Strength Low-Alloy Structural Steel
ASTM A536	Ductile Iron Castings
ASTM D1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D2241	Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2657	Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D3139	Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
ASTM D3350	Polyethylene Plastics pipe and Fittings Materials
ASTM D5260	Classification for Chemical Resistance of Poly (Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

2100.3 CONSTRUCTION. Restrained joints for force mains shall be provided at all force main adjustments, canal crossings, horizontal bends or on other locations as specified. All force mains shall be installed in accordance with recommendations from the pipe manufacturer. All materials found to have flaws, cracks or other defects (including ultraviolet degradation), whether before or after installation, will be rejected and will be repaired or replaced by the Contractor as directed by the City, at no additional cost.

Pipe and fittings shall be kept clean and shall be thoroughly cleaned before installation. Pipe shall be laid to alignment and grades as indicated on the plans. Unless written permission is given by the Engineer, the pipe shall not be strung more than what can be accomplished in one day.

2100.3.1 Force Main Installation. Pipe shall be handled with care at all times to avoid damage. Proper equipment shall be used to lower sections of pipe into the trenches. Pipe shall be placed at the site of the work, parallel with the trench alignment and with bell ends facing the direction in which the work will proceed. Pipe shall be kept free from all rocks, dirt, and debris during installation. At the close of each work day, the open end of the pipe shall be effectively sealed against the entrance of water, dirt or other foreign materials. Pipe shall not be installed in water or when trench or weather conditions are unsuitable.

Full responsibility for the diversion of drainage for dewatering of trenches during construction shall be borne by the Contractor (see Trench Dewatering, Section 1005).

All pipe shall be installed accurately to established lines and grades with fittings and accessories at the required location and with joints centered and spigots pushed home. Location, alignment and grade of pipe shall conform to the drawings unless otherwise approved by the Engineer.

Trench construction for all pipes shall be performed in accordance with the installation instructions of the pipe manufacturer and Section 1002. Excavated trench shall be of sufficient width to allow proper handling of the pipe and thorough compaction of the backfill around the pipe.

When necessary to deflect pipe vertically or horizontally from a straight line, to avoid obstructions or other

reasons, as approved by the Engineer, the degree of deflection at any joint shall not exceed the pipe manufacturer's recommendations. Trace wire shall be installed adjacent to all non-metallic force mains. Trace wire shall be 14 gauge single strand plastic coated copper trace wire.

2100.3.1.1 Mechanical Restraints. All pipe fittings (bends, tie-ins, valves, etc.) shall be restrained using mechanical thrust restraints. Restraint lengths shall be as specified in the Plans and Specifications. Restrainted lengths and restraint type shall be as approved by the Engineer. Where indicated on the drawings, or otherwise required by the contract documents, all pipe joints (pipe to pipe connections) shall be restrained. Restrainted joints shall meet requirements of AWWA C110, C111, C151, and C153 standards. Joint design shall utilize a high strength ductile iron or structural steel gland assembled on the pipe along with retainer lugs, conforming to ASTM A536 strength requirements, latest revision. Stainless steel or corrosive resistant high strength alloy nuts, bolts and rods, conforming to ASTM A242 and AWWA C111, shall complete the restrained joint assembly, delivering a full circumferential contact and support of the pipe wall.

2100.3.1.2 Concrete Thrust Blocking. Concrete thrust blocking shall be used where called out in the contract documents. Class A concrete shall be placed, as shown on the construction plans or as otherwise directed by the Engineer, in such a manner that will substantially brace the pipe against undisturbed trench walls.

Concrete blocking, made from Type I cement, shall have been in place four (4) days prior to testing the pipeline as hereinafter specified. Test may be made two (2) days after completion of blocking if Type III cement is used. See STANDARD PLANS No. 3000-4; 3000-5 & 3000-6.

Concrete blocking, unless otherwise specified, will not be measured or paid for as a separate item, but the cost thereof shall be included in the various items listed in the proposal.

2100.3.2 Pressure Test for Force Mains. See Section 2300 for pressure testing requirements.

2100.4 MEASUREMENT AND BASIS OF PAYMENT. Measurement of work for payment of this item shall be by the actual linear footage installed, in the various sizes required, as specified and as shown on the drawings. Measurement for the linear footage of force main installed will be measured horizontally along the top centerline of the pipe through the bends and fittings.

Payment of the amount for this item shall be full compensation for furnishing all labor, materials, equipment and incidentals required to furnish and install the force main as specified and as shown on the drawings. The actual linear footage of force main installed and measured as provided above, will be paid at the respective unit prices bid for force main of the various sizes and classifications.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2100(1)	Sewer Force Main (All Types)	Linear Foot (LF)

SECTION 2200

SANITARY SEWER MANHOLES

2200.1 GENERAL. This section covers installation of precast manholes for the sanitary sewers within the City jurisdiction. The manholes are placed at change in grade and alignment, and for connecting lateral sewers.

2200.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Latest editions of the following standards shall be applied.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

M-306	Standard Specification for Drainage, Sewer, Utility, and Related Castings

ASTM INTERNATIONAL (ASTM)

ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM C361	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe

ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections

ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

ASTM D638 Tensile Properties of Plastics	Standard Test Method for

ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

ASTM F594 Nuts	Standard Specification for Stainless Steel

U.S. ARMY CORPS OF ENGINEERS

C-200	Coal Tar Epoxy Coating

2200.3 CONSTRUCTION.

2200.3.1 Precast Concrete Manhole. The Contractor shall assemble and install precast manhole sections in accordance with this section, and as shown in STANDARD PLAN No. 2200-I. All manhole sections are to be carefully off loaded with the use of "Spreader Bars" to avoid structural damage. The Contractor shall inspect for damage or defects immediately following off loading at the job site. Manhole

section(s) containing structural cracks, fractures to tongue and groove joints or any other damages that would weaken the integrity of the manhole shall be rejected and shall be replaced with quality sections. Sections containing acceptable minor surface damage may be field repaired prior to installation. The Contractor must make all minor repairs in accordance with the manufacturer's recommendation. The Contractor shall replace any structurally damaged and/or defective manhole section(s) when so directed by the City or Engineer.

The Contractor shall begin manhole installation by first preparing a safe open trench and establishing a dry compacted bottom to secure the manhole's base and pipe flowline elevation(s). Prior to setting the manhole base in place, the Contractor shall install a minimum twelve (12") inches of compacted coarse granular bedding, as per Section 1002 herein, onto the trench bottom. The coarse granular foundation shall clear the manhole's base circumference by a minimum of 6-inches, and shall extend to the limits of excavation. If unsuitable soil conditions are encountered during trench bottom excavation, then by direction of the Engineer, the Contractor shall install suitable stabilization material(s), as identified in Section 1002 "Excavation and Backfill". Once the bottom foundation is secured, the Contractor shall carefully set the manhole base in-place, thence level and establish the plan identified pipe elevation(s) by use of survey instruments. The Contractor shall then secure all manhole pipe connections and tamp-in the remaining pipe bedding material up to the manhole. Once the manhole base and pipes are complete in-place the contractor shall fill the periphery space around the connected pipe(s) with non-shrink grout in accordance with the gasket seal manufacturer's direction.

Prior to installing each adaptable manhole riser section, the contractor shall install a flexible lubricated artificial rubber gasket, as described in Section 209.7.1.8 "Manhole Water Stops", into the tongue or groove joint to ensure an air tight seal. Then each manhole riser section shall be carefully fitted together, tongue to groove, to build the manhole to finished grade.

Progressive backfill compaction shall be in layers not exceeding twelve (12") inches, measured loose, and compacted to 95% Standard Proctor Density. Contractor must use hand operated vibratory equipment within a minimum five (5) foot circumference space from the manhole. Heavy equipment-excavation buckets will not be permitted to perform this backfill compaction work.

Concrete grade rings may be necessary to adjust the top cone section to the finished elevation. Following the installation of the top cone section ring & cover, the Contractor shall apply a non-shrink grout to the perimeter of the manhole ring forming a finished collar. If concrete grade rings are used for adjustment to finished elevation, the Contractor shall apply surface mortar to seal the inside and outside joints of the grade rings.

Within the City-imposed two (2) year, 10%, contract maintenance period, the prime construction contractor and/or private developer shall be liable for any manhole top elevation adjustments or manhole relocations caused by changes in street grades, property grades and subsequent building or private driveway installations, which are unrelated to City of Shreveport involvement.

2200.3.2 Precast Transitional Manholes. The contractor shall furnish and install precast transitional manholes as required by the Engineer. Transitional manholes are used to neck down a 60-inch and larger diameter manhole to a 48-inch finished grade manhole. The bottom manhole unit shall be minimum seven (7) feet in vertical depth from the crown of the sewer pipe to the point of beginning the concentric reducer. (Refer to STANDARD PLAN No. 2200-4) herein.

2200.3.3 Installing New Manhole over Existing Sewer Main. The Contractor is responsible for verifying all site conditions where a new manhole will be installed over the existing sewer main. This includes checking elevations, depths and diameter of the existing in-ground pipe(s). Plans, profiles and record drawings provided by the Engineer, local utilities, or other agencies of government or private firms are for the Contractor's general information only. The accuracy of these documents relative to the actual underground piping cannot be guaranteed, since it is a recognized fact that underground piping is known to deflect, to settle, to become disjointed or displaced, and to slightly shift or migrate from its originally

installed position, etc. Consequently, the Contractor is responsible for independently reviewing and verifying the accuracy of all documents furnished to him. Any major field discrepancies shall be brought to the immediate attention of the Engineer.

The Contractor's decision not to verify and confirm the accuracy of drawings furnished by the City or by others is at the Contractor's sole risk. The Contractor shall have no cause for additional compensation or time, due to his failure to verify the actual conditions and dimensions of underground water and sewer systems.

Once the local conditions and field dimensions are confirmed, the Contractor shall have his shop drawings prepared, stamped and submitted for City review as detailed above. The contractor shall also provide a detailed bypass flow pumping operation to prevent disruption of the existing sewer system's flow and to maintain safe and dry trenching conditions during construction of the new manhole and existing pipe connections including a barrier method for equipment noise control.

The existing sewer line must be carefully excavated and prepared for installing the new manhole. Every precaution should be taken to ensure that the existing sewer line(s) is properly braced and supported to remain on line, grade and elevation during the excavation and construction work. It is essential that the existing sanitary sewer line(s) connecting to the manhole not be cut out or removed until after the cast-in-place manhole base section has properly cured and can support the subsequent installed riser sections.

There are two (2) accepted methods of building a manhole over an existing municipal sewer main. The primary method involves setting a new precast manhole base section (with pre-cored inverts) into the existing sewer main while performing a bypass flow pumping operation. This method of installation involves cutting and removing an existing segment of sewer pipe(s) and installing applicable factory conversion/adaption fittings to re-connect existing pipe-to-manhole and/or dissimilar pipe-to-pipe. The pre-installation of coarse granular bedding and subsequent vertical precast manhole riser(s) assembly shall comply with the requirements of this specification section.

If the existing sewer flows are determined to be too complex to divert and perform segmented sewer pipe removal, then a secondary method of building a manhole over the existing sewer main(s) is accepted. This is performed by setting a precast (dog house style) manhole base section directly over the pre-supported existing in-place sewer pipe(s), and compressing the base section into a formed concrete poured slab while uncured.

During the concrete slab's curing period, the base section must be hoist restrained from above to prevent damaging and/or pushing the existing pipe(s) out of line and grade. After the concrete slab has set-up, an 8-inch wide concrete collar shall be formed around the perimeter of the manhole base section at the point of connection with the slab. The (dog house) base section wall cut-outs shall be cast so the periphery pipe clearance is not more than 2-inches greater than the straddled existing sewer pipe(s).

The concrete slab shall be (timber or metal) formed (square or round) and the outside dimensions shall exceed the manhole base perimeter by a minimum of twelve (12") inches unless otherwise shown on the plans.

The concrete slab shall be a minimum twelve (12") inches thick and shall rest on a minimum twelve (12") inch thick bed of compacted coarse aggregate, extended a minimum of six (6") inches beyond the perimeter of the slab unless otherwise shown on the plans. The concrete poured slab shall contain steel mesh reinforcement assembled throughout the bottom half of the pour. A solid layer of (3 mil. min. thickness) polyethylene film shall be applied between the coarse aggregate foundation and the cast-in-place manhole base section. Refer to STANDARD PLAN No. 2200-2.

It is essential that a water-tight seal be obtained and maintained around all sewer lines entering the manhole. The water stop requirements detailed in Section 209.7.1.8 shall apply for this type of work.

2200.3.4 Cast-in-place Manhole Coatings. Cast-in-place manhole sections must be field coated by the construction contractor with coal tar epoxy on all internal surfaces of the manhole, and coated on the exterior surfaces with a bituminous coating as specified in Section 209.7.1.3 herein. Manholes requiring locked sealed covers and/or force mains drop structures shall be coated, and manholes requiring a monolithic liner shall be in accordance with Section 209.7.1.4 herein. The method used for application shall be performed in accordance with the manufacturer's recommendation.

2200.3.5 New Pipe Connections to Existing Manholes. New sewer pipe connections to existing manholes (point of new line termination) shall not be performed until all other in-line manholes and sewer lines have been completed, internally cleaned, tested, and inspected in accordance with all applicable specification standards herein. When connecting new sewer mains (up to 12-inches in diameter) into existing manholes, the wall of the manhole shall be core bored, per designed plan elevation, to a sufficient diameter permitting the connecting sewer pipe to penetrate the manhole containing a watertight gasket, conforming to the waterstop requirements in specification Section 209.7.1.8 herein. Where the gravity outfall lines discharge into an existing manhole, the flow of sewerage must be diverted around this construction. The contractor must intercept the sewage flow at the first existing manhole upstream from the construction and shall provide adequate sized pumping equipment and rerouting conduit to pump the sewage around the manhole under construction. The pumped sewage discharge shall be diverted into an appropriate manhole downstream from the point of construction.

Pipe connections to existing manholes shall be made so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for new pipe shall be of sufficient diameter to allow packing non-shrink grout around the entire periphery of the pipe but no longer than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

2200.3.6 Manhole Stub-outs. When it is determined that a sewer line is feasible to be extended for future system improvements and/or future property development, one minimum full joint of pipe shall be stubbed-out from the manhole(s) at the pre-determined size, direction and elevation. The terminating end of the stubbed-out pipe shall be a standard bell-end containing a watertight plug. The stub-out pipe shall be bedded in coarse granular material as identified in Section 1002 herein. Standard air-test procedure shall be performed following completed installation. Manhole stub-outs will not be measured or paid for separately but shall be included in the cost for manholes.

2200.3.7 Manhole Frames and Covers. Manhole frames and covers shall be cast of the size, shape and model indicated on STANDARD PLAN No. 2200-6 and as specified herein. They shall be readily adaptable to grade rings as specified herein. Finished top of manhole rings and covers shall be installed level within natural ground surface areas, except where in public right-of-way, the top shall be set flush within pavements, sidewalks or other surfaced areas. Where manholes are installed in a recorded flood zone, the finished top elevation must be constructed to set above the base flood elevation.

Standard frame and cover units shall be used unless otherwise indicated on the drawings and/or included in the bid proposal form. Manholes equipped with locked and sealed covers must contain an exterior pipe ventilation system above the ground surface, as specified in STANDARD PLAN No. 2200-5 herein (Subject to the appropriate locations and conditions).

When directed by the Engineer, elastomeric manhole frames and covers shall be used for manholes with highly corrosive conditions. Elastomeric frames and covers shall be as manufactured by Hamilton-Kent or approved equal. See Standard Specification Section 2210.12 for more details regarding elastomeric frames and covers.

The contractor must thoroughly surface clean and then apply a coating of multi-black asphalt base paint to all manhole frame and cover castings.

2200.3.8 Manhole Grade Rings. Concrete grade rings shall be manufactured in accordance with the provisions of ASTM C478 and cast with corresponding tongue and groove as indicated on STANDARD PLAN No. 2200-1 herein. They shall be used for grade adjustments in both precast and cast-in-place manholes.

All grade rings shall be adaptable to the cone and frame section with a one piece rubber compression gasket installed into the tongue and groove joint, to obtain low pressure sealed joints. Where manholes are constructed in traffic bearing areas, the one piece rubber compression gasket may be substituted with an approved butyl rope material for a more stabilized seal. (Ram-Nek material is prohibited).

Gaskets for grade ring sections shall be three quarter (3/4") inch circular cross-section, one piece rubber conforming to ASTM C361 and C923 (See STANDARD PLAN No. 2200-1). Contractor is to apply interior and exterior epoxy surface coatings as identified for manholes in Sections 209.7.1.3 and 209.7.1.4 herein.

2200.3.9 Manhole Bypass Pumping Operations. When it becomes necessary to set up manhole bypass pumping operations, the Contractor shall be responsible for the development and submittal bypass pumping plan to demonstrate that he has the proper size pumping equipment and hoses to handle peak inflow rates, (approx. 500% of daily average peak flow rates as shown on the plans or provided by the Engineer) for the particular sewer main that is being bypassed. This plan shall include additional signs and barricades as necessary to protect the public as well as the work for the duration of the bypass pumping operation. The Engineer shall review the plan and approve the Contractor's proposed pump and hose sizes and noise abatement muffling system before installation of the equipment. The Contractor shall install "Roll Planking" on both sides of the bypass hose to protect it from both street and driveway traffic. All bypass pumping operations must be maintained within public and/or dedicated right-of-way.

The bypass shall be made by plugging the line at an existing upstream manhole and pumping the sewer flow into a downstream manhole or adjacent sewer system. The Contractor shall provide continuous monitoring of the pumping operations and is responsible for the water tightness of the pumping system so as to assure that raw sewage is not leaked or dumped anywhere outside of the normal sewage containment system. The Contractor shall immediately notify the City Water and Sewerage Department's Service Center or Dispatch Office (318-673-7600) in the event of sewage spill and shall take immediate clean up action. Such cleanup work shall be at the Contractor's expense. In addition, the Contractor shall follow the required EPA reporting procedures to assure that the EPA is properly notified in a timely manner.

In the event heavy rainfall begins to occur while by-pass pumping operations are underway and the sewer system is threatened by a storm water surge, the Contractor should have personnel in place to assure that pump rates are increased to meet the increased demands of the system and to assure that the pumping system does not become clogged by storm water debris that may get into the sewer system. All manhole bypass operations in its entirety shall be the contractor's responsibility.

2200.3.10 Construction Maintenance. Sanitary sewer manholes must be thoroughly cleaned and maintained in workable conditions until the project has been issued a final completion of work from the City.

2200.3.11 Manhole Air Vacuum Test. The contractor shall test all manholes installed in gravity flow sanitary sewerage systems using inflatable compression bands, vacuum pump and appurtenances specifically designed for vacuum testing manholes (At No Direct Payment). Test procedures shall be in accordance with the test equipment manufacturer's recommendations, and Section 2300, "Sanitary Sewer Testing of Pipes and Manholes".

2200.4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

2200.4.1 Sanitary Sewer Manholes. Manholes shall be paid for per each unit for the first ten feet of depth per bid proposal. Manholes that are over ten feet in depth shall be paid for by vertical foot as per bid proposal. The depth of the manhole shall be measured from the top of the manhole casting to the invert of the deepest pipe or the invert of the manhole. Manhole stub-outs will not be paid for separately and shall be included in the cost for manholes complete in-place. (See Section 2200.3.6, herein)

The contract price shall be considered full compensation for furnishing all materials, tools, equipment, labor and appurtenances, and performing all work necessary for the new manhole installation including bedding, setting, joining, cleaning, sealing, the connection of the sewer pipe(s) in accordance with the plans and the provisions of these specifications and testing.

No additional payment will be made for excavation, sheeting and bracing (except approved extra sheeting and bracing left in place and paid for under other items), backfill and compaction, testing and removal of excess earth. No direct payment shall be made for de-watering, including pumping, and other necessary operations for preparing the manhole installation.

2200.4.2 Connections to Existing Manholes. Connections to existing manholes will be measured and paid for at the contract unit rate based on the actual count of each connection completed in-place and accepted. Payment shall constitute full compensation for furnishing, hauling and installing all materials complete in-place, for all excavation, sheeting and bracing (except extra sheeting and bracing left in-place and paid for under other items), backfill and compaction, removing surplus earth; and for the furnishing of all equipment, tools, labor and incidentals necessary to complete the item as shown on the drawings.

No direct payment will be made for a new sewer pipe connection (includes rehabilitation) to an existing sewer manhole involving the direct connection to an existing sewer pipe stub-out.

2200.4.3 Manhole Bypass Pumping. Bypass pumping operations shall be measured on a lump sum basis rated over the duration of the project, unless otherwise approved by the Engineer, for all work completed and accepted in accordance with the contract documents. Payment shall be at the contract lump sum price and shall be full compensation for all labor and equipment for all bypass pumping set-ups, continuous sewage flow pumping operations and full time monitoring of operations, including sewage containment.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2200 (1)	Sanitary Sewer Manhole (up to 10-ft)	Each
2200 (2)	Sanitary Sewer Manhole (more than 10-ft)	VF
2200 (3)	Connections to Existing Manholes	Each
2200 (4)	Manhole Bypass Pumping	Lump sum

SECTION 2210

MANHOLE REHABILITATION

2210.1 GENERAL. Contractor shall furnish all labor, materials, equipment and incidentals required to rehabilitate manholes. This specification may include materials, techniques and work for manhole rehabilitation that may not apply to all projects. Contractor shall perform manhole rehabilitation work as indicated in the Contract Documents. This specification shall be used in conjunction with the City's Standard Specification Section 2220, for work involving installation of monolithic manhole liners.

2210.2 SCOPE OF WORK. Furnish all labor, materials, equipment and incidentals required to rehabilitate manholes as noted on the Drawings and as specified herein.

Contractor shall clean the manhole, dispose of the sludge, deposits, debris etc. in accordance with local, State and Federal regulations, patch manhole exterior; stop infiltration with chemical grout; rebuild invert and benching; reset or replace manhole frame and cover assemblies; install chimney seals and/or locate and/or raise manhole frame and cover assemblies, and perform other pertinent work as directed by the City/Engineer. Complete this work in accordance with the Contract Documents.

Remove manhole steps unless otherwise directed by the City or Engineer. Eliminate active infiltration observed in the frame seal, chimney (corbel for brick manholes), cone, wall, bench, invert, holes, or pipe connections prior to applying the manhole lining system. Reinstall existing manhole rings and covers removed to allow the completion of the rehabilitation work. Restore the site to its pre-maintenance condition as approved by the City or Engineer.

Maintain sewer flows as specified in the City's Standard Specifications Section 2200.

2210.3 REFERENCES. The publications listed below form a part of this specification to the extent referenced, the publications are referred to within the text by the basic designation only. All publications are of most recent version unless otherwise noted.

ASTM INTERNATIONAL (ASTM)

ASTM C94	Standard Specification for Ready-Mix Concrete.
ASTM C109	Standard Test Methods for Compressive Strength of Hydraulic Cement Mortars (Using 2-in Cube Specimens)
ASTM C150	Standard Specification for Portland Cement.
ASTM C267	Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
ASTM C293	Standard Test Method for Flexural Strength of Concrete" (Using Simple Beam with Center-Point Loading).
ASTM C309	Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.

ASTM C496	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
ASTM C579B	Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing
ASTM C596	Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems used with Concrete by Slant Shear.
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
ASTM D395	Standard Test Methods for Rubber Property Compression Set.
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
ASTM D573	Standard Test Method for Rubber-Deterioration in an Air Oven.
ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
ASTM D1149	Standard Test Methods for Rubber Deterioration-Cracking in an Ozone Environment.
ASTM D2240	Standard Test Method for Rubber Property-Durometer Hardness.
ATSM F2414	Standard Practice for Sealing of Sewer Manholes Using Chemical Grouting.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

The revision of the above standards that is in effect at the time of bid opening will apply.

2210.4 SUBMITTALS. Identify the staging area for deployment of manhole repair equipment for each work area.

Submit to the Engineer, shop drawings and product data for all manhole rehabilitation materials specified in this Section for each manhole to be rehabilitated.

1. Information on all materials that will be used, the installation method(s), and equipment. For the materials that will be used, identify and furnish references for successful use of the materials in similar applications.
2. Method for sealing pipes at manholes.

2210.5 QUALITY ASSURANCE. The Contractor or Subcontractor, or their personnel, to perform the manhole rehabilitation and manhole lining shall be fully qualified, experienced and equipped to complete the work in a timely and satisfactory manner. Submit the following information to the Engineer for review and approval before any work is performed.

The number of years of experience Contractor or applicator have in performing this type of specialized work; with a minimum of 5 years of experience.

Contractor, or their personnel, shall have successfully installed the proposed lining system in a minimum of 500 manholes.

Name of the manufacturer and supplier for this work and previous work performed. The Contractor, or their personnel, shall be certified by the manufacturer to install the monolithic lining system.

A list of all municipal installations performed by the manufacturer and Contractor, or their personnel, over the past 5 years along with the contact name, telephone number, and brief description of work performed.

The Contractor shall also be capable of providing crews as needed to complete this work without undue delay.

The City reserves the right to disapprove the use of the Contractor, sub-contractor, or their personnel, based on the submitted qualifications.

2210.6 GUARANTEE. All manhole rehabilitation work shall be guaranteed by the Contractor for a period of two years from the date of final completion. During this period, all defects in the lining shall be repaired in a manner satisfactory to the Engineer or the lining shall be re-applied at no cost to the City. In the months following final completion of the manhole rehabilitation work (but within 24 months), the City shall inspect all of this work to ensure proper performance. If any deficiencies are found during these inspections, the Contractor shall repair them at no additional cost to the City.

2210.7 DELIVERY, STORAGE AND HANDLING. Care shall be taken in shipping, handling and placing to avoid damaging the chemical grouts, cementitious materials, and other manhole rehabilitation products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the Engineer.

The Contractor shall promptly inspect all delivered materials for damage. Any materials showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work. While stored, the materials shall be adequately packaged and protected. The materials shall be stored in a manner as recommended by the manufacturer.

2210.8 PRODUCTS AND MATERIALS.

2210.8.1 Materials to Stop Active Leaks. To stop active leaks in the manhole, the contractor must use one or more of the following materials and procedures to stop the active leaks prior to lining.

Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug - This material shall consist of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents, or promote the corrosion of steel it may come in contact with. The cement plug should have the following minimum requirements:

Minimum Requirements		
Compressive Strength	ASTM C109	>1000 psi, 1hr. >2500 psi, 24 hrs.
Sulfate Resistance	ASTM C267	No weight loss after 15 cycles @ 2000 ppm
Freeze/Thaw	ASTM C666 "Method A"	100 cycles
Pull Out Strength		14,000 lbs.
Set Time		<5.0 minutes

Chemical Grout - Identify the type of chemical grout that will be furnished for the project. The chemical grout to be used shall be in accordance with the manufacturer's recommendation for the specific application. The chemical grout shall be a formula that is suitable for application in a manhole that is susceptible to frost, if applicable for the regional climate.

- Drilling and injection method shall use a hydrophilic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the Engineer.
- Exterior chemical curtain grouting method shall use a hydrophobic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the Engineer.
- Expanded Gasket Procedure shall use Oil Free Oakum with hydrophilic polyurethane chemical grout manufactured by Avanti or equal used for sealing larger cracks and manhole joints, unless otherwise approved by the Engineer.

Obtain the Engineer's approval of materials to stop active leaks before starting the Field Work.

Obtain the Engineer's approval of application equipment prior to starting the Field Work.

2210.9 PATCHING, REPOINTING, FILLING AND REPAIRING NON-LEAKING HOLES, CRACKS AND SPALLS IN THE CONCRETE AND MASONRY MANHOLES.

A quick-setting cementitious material shall be used as a patching material and is to be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Physical Properties		
Compressive Strength	ASTM C109	>1800 psi, 1 hr. >2600 psi, 24hr. >3000 psi, 28 days
Bond	ASTM C882	>1600 psi, 28 days
Applied Density		105 lbs. pcf $\pm$ 5 lbs.
Shrinkage	ASTM C596	0% at 90% R.H.
Placement Time		5 to 10 minutes
Set Time		15 to 30 minutes

The water used to mix product shall be clean and potable. Questionable water shall be tested by a laboratory per ASTM C94 procedure. No material (other than water) shall be used with or added to the patching product without approval or recommendation from manufacturer.

2210.10 COATINGS FOR ALL INVERTS. A quick-setting material shall be used to coat the invert and is to be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Physical Properties		
Compressive Strength	ASTM C109	>1800 psi, 1 hr. >2600 psi, 24hr. >3000 psi, 28 days
Bond	ASTM C882	>1600 psi, 28 days
Applied Density		105 lbs. pcf $\pm$ 5 lbs.
Shrinkage	ASTM C596	0% at 90% R.H.
Placement Time		5 to 10 minutes
Set Time		15 to 30 minutes

Water used to mix product shall be clean and potable. Questionable water shall be tested by a laboratory per ASTM C94 procedure. No material (other than water) shall be used with or added to the patching product without approval or recommendation from manufacturer.

2210.11 INTERIOR FLEXIBLE CHIMNEY SEALS. Provide a flexible seal to provide corrosion protection and to prevent infiltration through the interior of the manhole frame and chimney area of the manhole.

Provide materials for Interior flexible chimney seal to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. The seal shall remain flexible allowing for repeated vertical or horizontal movements of the frame due to frost lift, ground movement, or the thermal movement of pavement. The final liner material shall be made no less than 170 mils of corrosion resistant flexible urethane resin coating to be applied to the inside wall of the entire chimney area as described above. Mil thickness may vary depending on the local climate. The product shall have a minimum elongation of 800% and a Durometer hardness of 75. Final liner shall have a minimum tensile and adhesion strengths of 1150 psi and 175 lb. l/in. respectively.

The manhole sealant shall conform to the physical requirements of ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension. Sealant shall be "Flex-Seal" as manufactured by Sealing Systems, Inc., Loretto, MN or approved equal.

2210.12 MANHOLE FRAME AND COVERS. Manhole frames and covers shall be cast iron. Cast Iron Manhole frames and covers shall be of good quality, strong, tough, even grained, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. See City's Standard Specification Sections 209 and 2200 for more details.

When directed by the Engineer, elastomer frames and covers shall be used in manholes with highly corrosive conditions. Elastomer Frames and covers shall be molded and cured in such a manner that any cross section will be dense, homogeneous, and free of porosity, blisters, pitting and other imperfections. The basic polymer shall be natural rubber, synthetic rubber, or a blend of both that is acceptable to the City. The elastomer shall meet the following minimum requirements:

Elastomer Properties					
Material Property	ASTM Standard	Test Requirements	Natural Rubber 85 Durometer	Synthetic Rubber 85 Durometer	Units
Physical Properties	D2240 D412	Hardness Min. tensile strength Min. ultimate elongation	85 +/- 5 1500 300	85 +/-5 1500 300	Shore "A" points psi percent
Heat Resistance	D573 at Specified temp.	Specified temp. of test Aging time Max. change in durometer Max. change in tensile strength Max. change in elongation	70 168 +10 -25 -25	100 70 +15 -15 -40	°C Hours Shore "A" points percent percent
Compression Set	D395 Method B at Specified temp.	Specified temp of test Max. permissible change (after 22 hours)	70 -25	100 -35	°C percent
Low Temp Brittleness	D746 Procedure B	Tested at -40°C	passes	passes	
Ozone Resistance	D1149	Concentration of ozone Duration of test	25 48 No cracks	100 100 No cracks	mPa hours

Elastomeric frames and covers shall be as manufactured by Hamilton-Kent or approved equal. Refer to the City's Standard Specifications Sections 209 and 2200 for additional manhole frame and cover requirements.

2210.13 EXECUTION.

2210.13.1 GENERAL. Each manhole to be rehabilitated shall be thoroughly cleaned and then inspected for loose or missing bricks, loose mortar, holes, etc. Any protrusions or obstructions into the manhole shall be completely removed. All leaks shall be eliminated prior to applying the manhole lining system.

Damage incurred to the manhole or pipe segments due to methods and equipment employed by the Contractor is the responsibility of the Contractor. Damage to public and private property from sewer surcharging that results from material or equipment left in the manhole or sewer or from any flow blockage is the responsibility of the Contractor. The cost to repair the manhole or pipe segments and expenses incurred by the City as a result of the damage shall be the responsibility of the Contractor.

2210.14 SURFACE PREPARATION. Pre-rehabilitation surface preparation – any area to be repaired which requires bonding of new cementitious, epoxy, chemical or waterproofing material to existing cement or masonry shall be prepared as follows.

Clean the area with high-velocity water cleaning equipment to remove all foreign matter, oil, grease, wax and dirt. This includes removal of bitumastic coatings. The water cleaning pressure shall not be so high as to cause permanent damage to the existing manhole walls or other parts of the structure.

If foreign material remains after high-velocity water blasting, clean the manhole surface using an acid wash. The acid wash shall be muriatic acid (hydrochloric acid) at a ratio of 1 part acid (HCl) to 10 parts of water. The mixing, application and removal of the acid solution shall be in strict accordance with the manufacturers' recommendations and safety procedures. The acid solution shall remain on the manhole surface until all

signs of foreign material have been removed. Afterward, the acid solution shall be completely washed off with water.

Chip or chisel away all loose or defective material from the areas to be repaired. Furnish a firm mechanical key by undercutting whenever possible.

Allow interior surfaces of the manhole to dry thoroughly before applying epoxy manhole lining systems. Any large voids including holes left by the manhole rung removal shall be filled with quick setting patching mix. Remove protruding rubber gaskets between wall joints. Surface preparation shall be incidental to the manhole rehabilitation costs.

Existing manhole rungs/steps shall be removed, ground smooth and patched and not replaced. Step removal shall be incidental to the manhole restoration costs.

Sewer Line Protection – Place covers over the invert to prevent extraneous material from entering the sewer lines.

Drop Connections - Remove any interior drop connections anchored to manhole walls prior to installing the lining system. After installation and proper curing of the liner, re-install interior drop connections to their original condition prior to removal. If the existing drop connection is already damaged and cannot be reused, the City and the Engineer shall be informed immediately to decide the best course of action.

Conduct a visual inspection of each manhole after it is cleaned. All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate grout compatible with the lining. Remove all loose mortar and rubble of existing chimney (corbelling), cone, walls, benches and inverts. Prepare manhole to receive lining as necessary by reshaping and repairing benches, inverts, cone, walls, and corbelling where required. All interior surfaces shall be prepared as recommended by the lining manufacturer. Minimum requirements are as listed below:

All cracks and other voids shall be repaired and filled with suitable non-shrinking cements, sealants or grouts, including all voids between the existing sewer pipes and manhole walls. All patches shall be smooth and even with the manhole wall.

All surfaces shall be suitably prepared for the required bonding of the lining as recommended by the manufacturer.

2210.15 SEALING OF LEAKS IN INVERTS, BENCHES, WALLS, CONE, AND CORBELLING. Premixed fast-setting, volume-stable waterproof cement plug – seal unsealed lifting holes, unsealed step holes, and voids larger than ½ inch in thickness with a waterproof, quick setting mortar. Place water proof mortar according to manufacturer's instructions.

Manhole Sealing by Chemical Grout Application –Chemical grouting shall include the following:

Transporting, delivering, and storing the chemical grout shall be according to the manufacturers published directions and requirements.

Manhole Preparation – Repair the manhole frame and rings, and complete structural repairs before grouting the manhole. Cut roots and trim roots before grouting the manhole. Remove cracked or deteriorated material from the areas to be grouted.

Chemical Grout Formulation – Mix each batch of chemical grout according to the manufacturer's published directions and requirements.

Sealing Active Leaks – Use the Expanded Gasket Procedure, drilling and injection procedure and/or chemical curtain grouting to stop active leaks.

Expanded Gasket Procedure – The Expanded Gasket Procedure (EGP) shall be performed per ASTM F2414 and the chemical grout manufacturers recommended installation methods. This is performed by soaking dry Oil Free Oakum with hydrophilic polyurethane chemical grout. The resulting oakum/resin plug shall be forced into the opening until it sets. Perform the EGP to:

1. Control flowing water in larger cracks, joints, or pipe to manhole boots.
2. Seal drop or lateral connections, slip line terminal seals and open joints in RCP manholes.
3. Seal between the corbel and manhole rings.
4. Seal between the manhole rings and manhole frame.

Drilling and Injection Procedure – The drilling and injection procedure shall be performed per ASTM F2414 and the chemical grout manufacturers recommended installation methods to seal the manhole with chemical grout. Drill injection holes through the manhole at locations recommended by the manufacturer. Inject the chemical grout through the holes under pressure. Injection pressure shall not cause damage to the manhole structure or surrounding surface features. Inject chemical grout through the lowest holes first. Repeat the procedure until the manhole is externally sealed. Grout travel shall be verified by observation of grout to defects or adjacent injection holes. Drill additional injection holes as necessary to ensure grout travel. Do not inject grout from the ground surface. After chemical grout injection is complete, clean injection holes with a drill and patch with a waterproof, quick setting mortar for brick and concrete manholes. Perform the drilling and injection procedure to control flowing water in cracks.

Curtain Grouting – Shall be performed per ASTM F2414, Sealing Sewer Manholes Using Chemical Grouting and the chemical grout manufacturers recommended installation methods. Perform the curtain grouting procedure when there are multiple active leaks and the drilling and injection procedure does not eliminate the active leaks.

2210.16 INVERT CHANNEL COATING. All invert channels shall be coated with a material that is compatible with the manhole lining system per the manhole lining manufacturer's recommendations to prevent infiltration and to build up the invert channel to the invert elevations of the new sewer main or cured-in-placed lined sewer; to fill all voids, cracks, holes, etc.; and to form a smooth flow channel. The entire channel shall be coated. The coating shall be troweled uniformly onto the invert at a minimum ½ inch in thickness or as recommended by the manufacturer. The coating shall extend out onto the bench of the manhole sufficiently to tie into the monolithic liner.

The material used for the invert channel shall be suitable for the intended purpose and shall be compatible with the materials used for the manhole lining system. The material for the invert channel shall be as recommended by the cementitious liner manufacturer and installed in accordance with the manufacturers recommended installation instructions and procedures. Coating the invert may be waived when the invert is in excellent condition and upon approval by the City or Engineer

2210.17 LOCATING, RAISING, RESETTING, AND/OR REPLACING MANHOLE FRAME AND COVER ASSEMBLIES. Locate and uncover buried manhole frame and covers; remove existing manhole frame and covers; dispose of existing manhole frame and covers, if they are not being reused; and install new or reused manhole frame and covers as directed by the city and/or engineer. Repair any damage to the manhole chimney or corbelling caused by the removal of the existing manhole frame at no additional cost to the city.

Existing frames and covers to be reused shall be thoroughly cleaned before re-installation.

If the existing frames and covers are not to be reused, properly dispose of the materials in accordance with

local laws.

When re-setting existing frames and covers, apply preformed flexible joint sealant Kent Seal No. 2 by Hamilton-Kent or equal.

Install new or reused frames so that the tops of the covers are at the required grade. Utilize precast concrete grade rings to set the manhole frame and cover to the finished grade. Precast concrete grade rings shall be set in a bed of butyl mastic sealant.

2210.18 CEMENT EXTERIOR. For raised manholes with damaged exterior; masonry manholes without an exterior cement coating; manholes where frame and cover assemblies are being replaced or reset; where noted on the drawings; or as directed by Engineer, the contractor shall repair existing or install new cement exterior coating for manholes as follows:

Contractor shall prepare the surface of the exterior of the manholes using the procedures outlined in section 2210.14 above.

Following preparation of the surface, spray or hand trowel the exterior from existing/finished grade to above the frame/chimney seal using the product specified in Paragraph 2210.8.1 and in accordance with the manufacturer's installation instructions. A minimum finished thickness of two (2") inches shall be applied.

A curing compound shall be applied in accordance with ASTM C309 to the exterior cement.

2210.19 FIELD TESTING AND ACCEPTANCE. The Engineer or City may enter the manholes to inspect the benching, invert channels, manhole wall/pipe connections, surface preparation, and other parts of the work.

Provide all equipment, hardware and materials, including but not limited to forced air ventilation, gas monitors and detectors, harnesses, lights, etc., necessary for the Engineer or City to enter the manhole and perform the inspection in complete accordance with OSHA requirements at no additional cost to the City.

The finished manhole surface shall be continuous and free from significant defects. Any defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the manhole shall be repaired at the Contractor's expense, in a manner mutually agreed upon by the Engineer and the Contractor.

No Active infiltration into the manhole shall be observed in the manhole as confirmed by visual inspection of the City or Engineer. Any infiltration found shall be repaired by the Contractor immediately at no additional cost.

The Contractor is responsible for coordinating inspection times with the Engineer.

2210.20 MEASUREMENT AND PAYMENT. Measurement of work for payment of this item shall be on a Lump Sum (LS) basis, per manhole rehabilitated. When this work is done in conjunction with lining a manhole, it shall be considered incidental to the manhole liner installation.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2210(1)	Manhole Rehabilitation	Each Manhole

SECTION 2220

MONOLITHIC MANHOLE LINING SYSTEMS

2220.1 GENERAL. Contractor shall furnish all labor, materials, equipment and incidentals required to install monolithic manhole liners. This specification may include materials, techniques and work for manhole liners that may not apply to all projects. Contractor shall install the monolithic lining system as indicated in the Contract Documents. This specification shall be used in conjunction with the City's Standard Specification Section 2210, for manhole preparation and rehabilitation.

2220.2 SCOPE OF WORK. For interceptor manholes or when the Contract documents specifically require a monolithic manhole lining system, the Contractor shall furnish all labor, materials, equipment and incidentals required and install and test manhole monolithic cementitious and/or epoxy lining system and Cured-In-Place Manhole (CIPM) for the purpose of eliminating infiltration and exfiltration, providing corrosion protection, repair of voids and restoration of the structural integrity of the manhole as a result of applying a monolithic liner to the wall and bench surfaces of brick, concrete or any other masonry construction material. Lining should extend from invert to top of cone, as specified. Type of manhole liner shall be per the Engineer's directions.

The Contractor shall accurately field measure and size each individual manhole. The Contractor is reminded that each existing sewer manhole designated to receive the monolithic lining may have a different configuration and varying field dimensions. All field measurements shall conform to the requirements of the monolithic lining manufacturer.

The manhole lining shall not be installed until other manhole rehabilitation as specified on the drawings and in Section 2210 – Manhole Rehabilitation work is complete. Procedures for manhole preparation and cleaning are included in specification Section 2210 – Manhole Rehabilitation.

The Contractor is advised that the presence or absence of leakage through manhole walls noted on the manhole inspection reports and as seen in the Contractor's independent inspection of manholes prior to bidding is dependent upon the ground water levels and conditions at the time of the inspections. High ground water levels in the project area can vary with rainfall in any given year. The Contractor shall reflect his/her assumptions and judgments on leakage through manhole walls based on this information in the unit prices bid for lining manholes. All leakage shall be stopped prior to lining manholes. No additional payment will be made to the Contractor for repairing leaks not visible prior to bidding or sewer rehabilitation.

2220.3 REFERENCE.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
ASTM C150	Standard Specification for Portland Cement.
ASTM C267	Standard Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing.
ASTM C293	Test Method for Flexural Strength of Concrete.
ASTM C321	Test Method for Bond Strength of Chemical-Resistant Mortars.

ASTM C496	Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
ASTM C579B	Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing.
ASTM C596	Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
ASTM D638-98	Standard Test Method for Tensile Properties of Plastics.
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
ASTM D695-96	Standard Test Method for Compressive Properties of Rigid Plastics.
ASTM C722	Standard Specification for Chemical-Resistant Resin Monolithic Surfacing.
ASTM C882	Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete.
ASTM C884	Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay.
ASTM D790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics.
ASTM D870	Practice for Testing Water Resistance of Coatings Using Water Immersion.
ASTM F 1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits By the Inversion and Curing of a Resin-Impregnated Tube.
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
ASTM D1763	Standard Specifications for Epoxy Resins.
ASTM D2247	Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
ASTM D2240	Standard Test Method for Rubber Property Durometer Hardness.
ATSM F2414	Standard Practice for Rehabilitation of Sewers Using Chemical Grouting.

ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
ASTM D5813	Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems.
ASTM D6132	Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.

Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

2220.4 SUBMITTALS. Submit to the Engineer, shop drawings, product data, and installation methods. Submittals shall include but are not limited to the following:

1. Manufacturer's product data, including physical properties, surface preparation, repair, application, curing, and field quality control procedures.
2. Manufacturer and applicator qualifications as specified in paragraph 2220.5 below.
3. Type of monolithic lining system to be installed for each manhole.
4. Diameter, depth (rim to invert), and material for each manhole.
5. Design data and specification data sheets listing all parameters used in the EMMLS and/or CIPM design and thickness calculations based on applicable provisions of ASTM C722 and/or ASTM F1216.
6. All design calculations shall be sealed by a Registered Professional Engineer in the State of Louisiana.
7. A list of all municipal installations performed by the manufacturer and Contractor over the past 5 years along with the contact name, telephone number, and brief description of work performed.

Submit to the Engineer, within 10 days of the Effective Date of the Agreement, the name of the supplier (manufacturer), installer and a list of materials to be furnished.

Submit a step-by-step description of the methods, practices, intervals, etc. to be used in the application and curing of the monolithic lining system to meet the requirements of this specification section.

2220.4.1 Test Reports.

Prior to each shipment of materials, submit certified test reports that the materials for this Contract were manufactured and tested in accordance with the ASTM Standards specified herein.

2220.5 QUALIFICATIONS. The Contractor performing the work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner. The Contractor shall submit the following information to the Engineer for review and approval before any work is performed.

The Contractor shall be certified by the manufacturer to install the monolithic lining system.

The Contractor and/or applicator shall have a minimum of 5 years experience or 500 manholes in performing this type of specialized work. This may be waived by the City through their product approval process with documented demonstration projects.

The Contractor shall also be capable of providing crews as needed to complete this work without undue delay.

The City reserves the right to disapprove the use of the Contractor based on the insufficient qualifications.

2220.6 GUARANTEE. All monolithic lining placed shall be guaranteed by the Contractor for a period of two years from the date of final completion. During this period, all defects discovered in the monolithic lining, as determined by the City or Engineer, shall be repaired or replaced in a satisfactory manner at no cost to the City. Such repair or replacement shall include the cost of removal and reinstallation. In the months following final completion of the manhole lining (but within 24 months), the City/Engineer will inspect all of this work to ensure proper performance. If any deficiencies are found during these inspections, the Contractor shall repair them at no additional cost to the City.

The Contractor is responsible for stopping all leaks prior to the installation of the monolithic lining system.

2220.7 QUALITY ASSURANCE. The supplier shall be responsible for the provisions of all test requirements specified in the above referenced ASTM Standards as applicable. In addition, all monolithic lining products to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the City. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspections approved for this Contract shall be borne by the City.

Inspections of the lining products and materials may also be made by the Engineer or other representatives of the City after delivery. The lining products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Lining materials rejected after delivery shall be marked for identification and shall be removed from the job at once.

The Contractor shall furnish the services of the cementitious manhole liner manufacturer's field service technician, who has complete knowledge of manhole rehabilitation, to advise and assist the cementitious manhole lining installation and provide instruction to the Contractor for rehabilitation of the first five (5) manholes. The field service technician shall be fully qualified and experienced in manhole rehabilitation work including cementitious, epoxy and/or cured-in-place manhole lining systems depending on the proposed lining system.

All monolithic epoxy lining shall be from a single manufacturer. The supplier shall be responsible for the provisions for all applicable test requirements specified in ASTM Standards for monolithic lining.

Inspections of the epoxy manhole monolithic liner material (EMMLM) may be made by the Engineer or other representatives of the City after delivery. The EMMLM shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though sample EMMLM may have been accepted as satisfactory at the place of manufacture. EMMLM rejected after delivery shall be marked for identification and shall be removed from the job at once.

2220.8 DELIVERY, STORAGE AND HANDLING. Care shall be taken in shipping, handling and placing to avoid damaging the lining products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the Engineer.

Any lining product showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

While stored, the lining products shall be adequately packaged and protected. The lining products shall be stored in a manner as recommended by the manufacturer.

Materials shall be stored, shipped and handled according to their material safety data sheet and the Manufacturer's recommendations. Any EMMLM damaged in shipment shall be replaced at no additional cost as directed by the Engineer.

Any EMMLM lining showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

2220.9 SAFETY AND SITE CONDITIONS. The Contractor and all Subcontractors shall comply with and enforce all Federal, State, and Local safety regulations. The Contractor's personnel shall be certified for confined space entry.

2220.10 PRODUCTS. The monolithic manhole lining system shall be designed and installed to protect concrete, brick, mortar, and other manhole surfaces from corrosion. The products shall be designed to stop infiltration, root intrusion, and further deterioration in the manhole. The interior surfaces to be protected shall include the walls, benches, inverts, pipe junctions and the chimney (corbel). The table below outlines the different monolithic manhole lining systems and the respective product specification paragraph(s) for each lining system. The pH limits listed below are typical and the type of manhole lining used shall be as shown on the drawings or as directed by the Engineer.

Typical manhole lining applications, based on hydrogen sulfide concentrations, and pH are as follows:

1. Portland Based Cementitious Liner: No or very mild hydrogen sulfide conditions, pH of 4.0 or higher.
2. Calcium Aluminate Cementitious Liner: Mild to harsh hydrogen sulfide conditions, pH of 2.0 or higher.
3. Epoxy Liner: Harsh hydrogen sulfide conditions, pH of 1.0 or higher. Structures with very turbulent flow such as pump station wet wells and forcemain discharge structures.
4. Cured-In-Place Manhole (CIPM): Harsh hydrogen sulfide conditions, pH of 1.0 or higher. Structures with very turbulent flow such as pump station wet wells and forcemain discharge structures. Severe infiltration and structural integrity issues.

Monolithic Manhole Lining System Type	Specification Paragraph
Portland Based Cementitious Liner	2220.10.1, Type 1
Calcium Aluminate Cementitious Liner	2220.10.1, Type 2
Epoxy Liner	2220.10.2
Cured-In-Place Manhole (CIPM)	2220.10.3

2220.10.1 Cementitious Manhole Monolithic Lining System. The manhole lining system shall be a monolithic, Portland based or calcium aluminate cementitious liner system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes.

The minimum thickness for Portland based cementitious lining shall be 1-inch thick. The minimum thickness for Calcium Aluminate based cementitious lining shall be 1-inch thick.

The cementitious lining system shall be:

Type I: Portland-based Cementitious Liner - no sulfide conditions (substrate surface of pH 4.0 or higher)

Strong MS-2A
 Quadex QM-1s Restore
 Standard Cement Re-liner MSP
 Permacast MS-10,000
 Mainstay ML-72
 Dinjer CMS 10K
 Or equal

The Portland-based cementitious liner product shall be used to form a structural monolithic liner covering all interior substrate surfaces and shall have the following minimum requirements:

Minimum Requirements – Type I Cementitious Manhole Lining System			
Compressive Strength	ASTM C109	28 days	>9000 psi
Tensile Strength	ASTM C496	28 days	>800 psi
Flexural Strength	ASTM C293	28 days	>1200 psi
Shrinkage @90% R.H.	ASTM C596	28 days	0%
Bond	ASTM C882	28 days	>2000 psi
Density, When Applied	-		134 ± 5lbs/ft ³
Freeze/Thaw	ASTM C666	N/A	300 cycles no visible damage

The Portland-based liner shall be made with Type I Portland Cement and shall be used according to manufacturer's recommendations in applications where there are no sulfide conditions (substrate surface of pH 4.0 or higher). The material should meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for any heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C94 procedure.

Type 2: Calcium Aluminate Cementitious Liner mild sulfide conditions (substrate surface of pH 2.0 or higher)

Strong MS-2C
 Quadex Aluminaliner
 Standard Cement Maximum CA
 Permacast CR-9,000
 Mainstay ML-CA
 SewperCoat
 Or equal

The calcium aluminate cementitious liner product shall be used to form a structural monolithic liner covering all interior substrate surfaces and shall have the following minimum requirements:

Minimum Requirements – Type 2 Cementitious Manhole Lining System			
Compressive Strength	ASTM C109	28 days	>9000 psi
Tensile Strength	ASTM C496	28 days	>800 psi
Flexural Strength	ASTM C293	28 days	>1500 psi
Shrinkage @90% R.H.	ASTM C596	28 days	0%
Bond	ASTM C882	28 days	>2000 psi
Density, When Applied	-		134 ± 5lbs/ft ³
Freeze/Thaw	ASTM C666	N/A	300 cycles no visible damage

The calcium aluminate cementitious liner shall be made with calcium aluminate cement and shall be used according to manufacturer's recommendations in applications where there is mild sulfide conditions (substrate surface of pH 2.0 or higher). The liner product shall be reinforced with alkaline resistant fiberglass rods or other similar fibers not less than 1/2 inch in length. The material should meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for any heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C94 procedure.

When cured, the monolithic cementitious lining shall form a continuous, tight-fitting, hard, impermeable surface which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

The monolithic cementitious lining shall cover the complete interior of the existing sewer manhole including the benches (shelves). The lining shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

The lining shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F. Provide test data on shrinkage of the cementitious lining based on ASTM C596.

If an internal flexible chimney seal is called for in the Drawings, then the lining shall be installed 1-inch below the bottom of the manhole frame. If no internal flexible chimney seal is called for in the drawings, then the lining shall be installed to 2 to 3 inches above the bottom of the manhole frame. The termination of and surface of the lining shall be suitable for proper installation of the manhole frame-chimney seal specified in Section 2210.

The cured system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole.

Chemical sealants, grouts or patching materials used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare the manhole surface prior to application of the system shall be fully compatible with the system.

The system shall provide a minimum service life of 25 years.

2220.10.2 Epoxy Monolithic Manhole Lining System (EMMLS) Harsh Sulfide Conditions (Substrate Surface of pH 1.0 Or Higher). The EMMLS shall be a resin-filled system suitable for use as a trowel-, spray- or spin-applied monolithic lining in sewer manholes. The resin shall be 100% epoxy resin.

The EMMLS shall conform to ASTM C722. The EMMLS materials shall be suitable for all the specified design conditions.

1. The EMMLS shall provide a minimum service life of 25 years.
2. The cured EMMLS shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole. Provide bond strength data on cured EMMLS based on ASTM C882 test method.
3. The cured EMMLS shall provide a minimum total thickness of 0.10 inches (100 mils). The cured lining thickness shall be continuous with proper sealing connections to all unsurfaced areas.
4. Chemical sealants or grouts used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare the manhole surfaces shall be compatible with the EMMLS.

When cured, the EMMLS shall form a continuous, tight-fitting, hard, impermeable lining, which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

The EMMLS shall bond to the sewer manhole being rehabilitated after being placed and cured. The EMMLS shall cover the complete interior of the existing sewer manhole including the benches (shelves), invert (channels or troughs) and pipe connections. The EMMLS shall provide a continuous watertight seal or barrier. The EMMLS shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

Provide water resistance data on EMMLS based on ASTM Standards D870 and D2247 test methods.

The EMMLS shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 30 degrees F to 80 degrees F. Provide test data on EMMLS thermal compatibility based on ASTM C884.

The EMMLS shall be separated from the manhole frame by a suitable joint. The joint shall be sealed with joint sealing tape.

The EMMLS shall be as manufactured by Raven Lining Systems, Warren Environmental, Sauereisen, AP/M PermaForm, WBE Dorcas Inc. or an approved equal.

2220.10.3 Cured-In-Place Manhole Liner (CIPM) Harsh Sulfide Conditions (Substrate Surface Of pH 1.0 Or Higher). The manhole liner system shall be a cured-in-place system suitable for use as a monolithic surfacing in sewer manholes. The cured in place liner system shall be Poly-Triplex Liner System, Terre-Hill, or approved equal.

The liner design and selection of materials shall be suitable for all the specified design conditions and shall meet the minimum requirements outlined in Table I. Thicker liners may be required based on design conditions. The liner shall be custom designed to fit each manhole and basis of design shall be submitted to the Engineer in accordance with Section 2220.4. It is the Contractor's responsibility to supply a CIPM liner that is most suitable for the existing conditions and that meets the requirements of this specification. Contractor shall assume the groundwater table is at grade for all sites for the purposes of liner thickness design unless otherwise instructed by the Engineer.

CIPM - Minimum Liner Physical Properties						
Manhole Depth (grade to invert)	Minimum Liner Thickness (in) (inch) ASTM D5813	Minimum Pre-Saturated Fabric Weight (ounces)	Minimum Flexural Modulus of Elasticity (psi) ASTM D790	Minimum Compressive Strength (psi) ASTM D695	Chemical Resistance Testing in accordance with ASTM F1216 Appendix X2	Chemical Resistance Testing in accordance with Greenbook Standards
0 to 10 ft.	0.117	56	1,000,000	11,000	PASS	n/a
10.1 to 15 ft.	0.117	56	1,000,000	11,000	PASS	n/a
15.1 to 20 ft.	0.158	68	1,000,000	11,000	PASS	n/a
(1) Minimum liner thickness includes only the strength portion of the liner. Non-structural layers are not included in minimum thickness requirements.						

The cured in place liner shall be installed on the benches, walls, channels, and inverts of existing manholes. The cured surface shall be smooth and continuous with proper sealing connections to all unsurfaced areas. The cured in place liner shall begin below the frame and the frame/liner interface shall be sealed using an epoxy.

The cured in place liner shall provide a minimum service life of 25 years.

The cured in place liner shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole. The cured in place liner shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage. The liner shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

The finished liner must be repairable at any time during the life of the structure. The liner shall be flexible, and have an elongation sufficient to bridge up to a 1/4-inch settling crack, without damage to the liner. The liner shall be able to bridge expansion cracks that may occur.

2220.10.4 Cementitious Manhole Lining Installation. The Contractor shall notify all property owners who discharge sewage directly to the manhole being surfaced that their service will be discontinued while the lining is being placed and cured, and active pipe and service connections are reopened. The Contractor shall notify individual property owners at least 72 hours in advance, giving the date, start time and estimated completion time for the work being conducted. This notification shall be coordinated with the distribution of door hangers.

When cured, the monolithic lining shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

The monolithic lining shall cover the complete interior of the existing sewer manhole including the benches (shelves) and inverts. The lining shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

The lining shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F. Provide test data on shrinkage of the lining based on ASTM C596.

The Contractor shall provide any necessary bypass pumping of sewage flows where and when the rehabilitation work is being performed, as specified in Section 2200.

The Contractor shall place covers over invert to prevent extraneous material from entering the sewer

lines.

The Contractor shall clean each sewer manhole to be surfaced and shall dispose of any resulting material as specified in Section 2210 Manhole Rehabilitation, Part 2210.15 and as follows.

1. Coatings that cannot be removed shall be sanded with coarse sand paper to rough the surface sufficient to obtain and insure adequate bonding of the EMMLS.

The Contractor shall conduct a visual inspection of each manhole after it is cleaned. All active, hydrostatic infiltration leaks shall be plugged or sealed with grout as specified in Section 2210 Manhole Rehabilitation. Remove all loose mortar and rubble of existing benches and inverts. Remove any protruding rubber gaskets between wall seams. Prepare manhole to receive EMMLS or CIPM if proposed as necessary by reshaping and repairing benches, inverts, and wall where required. Protect all pipe connections. All interior surfaces shall be prepared for EMMLS or CIPM as recommended by the manufacturer.

1. All cracks and other voids must be repaired and filled with suitable non-shrinking cements, sealants or grouts.
2. All surfaces shall be clean and structurally sound.
3. Manhole rungs/steps shall be removed, ground smooth and patched and not replaced. Step removal shall be incidental to the manhole restoration costs.

The Contractor shall remove interior drop connections anchored to manhole walls prior to installing the lining system. After installation and proper curing of the lining, the Contractor shall re-install interior drop connections to their condition prior to removal. If the drop connection is already damaged and cannot be reused, the Owner and the Engineer shall be informed immediately to decide the best course of action.

The liner mix shall be mixed as specified by the manufacturer for 30 seconds to 1 minute after all materials have been placed in the mixing hopper. Mixing shall be accomplished such that the mix can be sprayed in a continuous manner without interruption until each application is complete.

The surface shall be clean and free of all foreign material and shall be damp without noticeable free water droplets or running water, but totally saturated, just prior to application. Materials shall be applied to a minimum uniform thickness, to insure that all cracks, crevices and voids are filled and a relatively smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.

If a flexible chimney seal is called for in the Drawings, then the lining shall be installed 1-inch below the bottom of the manhole frame. If no flexible chimney seal is called for in the drawings, then the lining shall be installed to 2 to 3 inches above the bottom of the manhole frame. The termination of and surface of the lining shall be suitable for proper installation of the manhole frame-chimney seal, if specified.

The covers placed over the invert shall be removed and the bench sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/2 inch. The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

Caution shall be taken to minimize exposure of applied product to sunlight and air movement. At no time shall the finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing the manhole cover. In extremely hot and arid climates the manhole shall be shaded while reconstruction is in process. The final application shall have a minimum of four (4) hours cure time before being subjected to active flow. Traffic shall not be allowed over manholes for 24 hours after reconstruction is complete.

No application shall be made to frozen surfaces or if freezing is expected to occur inside the manhole within

24 hours after application. If ambient temperatures are in excess of 95 degrees F, precautions shall be taken to keep the mix temperature at the time of application below 90 degrees F. Mix water temperature shall not exceed 85 degrees F. Chill with ice if necessary.

After all preparation has been completed the Contractor shall remove all loose material and wash the walls again. Any bench, invert or service line repairs shall be made at this time using the quick setting patching mix and shall be used per the manufacturer's recommendations.

2220.10.5 Epoxy Coating Installation. The Contractor shall notify all property owners who discharge sewage directly to the manhole being surfaced that their service will be discontinued while the EMMLS is being placed and cured, and active pipe and service connections reopened. The Contractor shall notify individual property owners at least 48 hours in advance, giving the date, start time and estimated completion time for the work being conducted.

The Contractor shall provide bypass pumping of sewage flows where and when the rehabilitation work is being performed in accordance with Standard Specification Section 2200.

The Contractor shall furnish and place the EMMLS in the manhole. The installation of the EMMLS shall be in complete accordance with the applicable provisions of ASTM C722 and the manufacturers' specifications, and a representative of the manufacturer shall be present during the actual installation.

1. Prior to placing the EMMLS the manufacturer's representatives must approve the surface preparation work and installation conditions including temperatures.
2. All surfaces shall be sufficiently dry and even.
3. All bottom and horizontal surfaces including the benches and channels shall have the EMMLS applied to the required thickness by hand trowelling or spray-on methods.
4. All side vertical surfaces shall have the EMMLS applied to the required thickness by manufacturer's recommended methodology.
5. Temperature limitations must be handled as appropriate and as approved by the manufacturer.

All cutting and/or sealing of EMMLS at manhole pipe, cured-in-place liner, rungs and top connections shall provide watertight seals.

2220.11 CIPM INSTALLATION. Cured in place lining can be performed 24-hours after the cementitious repair coating was applied as long as it meets the cementitious coating characteristics specified in paragraph 2220.10.1.

Prior to placing the liner, the Engineer must inspect and approve the surface preparation work. The Contractor is responsible for ensuring proper installation conditions including temperature and moisture.

The liner tube shall be fully saturated with the selected resin at a site to be designated by the Contractor for approval. When fully saturated, the liner shall be inserted into the manhole per the manufacturer's instructions.

Once properly inserted and oriented, the liner shall be cured strictly according to manufacturer's instructions for that liner system. Heat cure time, cool down time and temperatures shall be recorded in a log for Engineer's review.

2220.12 FIELD TESTING AND ACCEPTANCE.

2220.12.1 General. The Engineer or City may enter the manhole(s) to inspect the benching, invert channels, manhole wall/pipe connections, surface preparation, and other parts of the work. Provide all equipment, hardware and materials, including but not limited to forced air ventilation, gas monitors and detectors, harnesses, lights, etc. for the Engineer or City to enter the manhole and perform the inspection in complete accordance with OSHA requirements at no additional cost to the City.

The finished manhole surface shall be continuous and free from significant defects. Any defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the manhole shall be repaired at the Contractor's expense, in a manner mutually agreed upon by the Engineer and the Contractor.

There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in the liner. If any defects are discovered after liner has been installed, it shall be repaired or replaced in a satisfactory manner within 72 hours and at no additional cost to the City. This requirement shall apply for the entire guarantee period.

Active infiltration through the lining system shall be zero.

The Contractor is responsible for coordinating testing times with the City/Engineer.

2220.12.2 Cementitious Manhole Monolithic Lining System. The cementitious lining shall provide a continuous monolithic surfacing with uniform thickness throughout the manhole interior. The Contractor shall work with the Field Representative to develop an easy method for measuring the liner thickness. This method should be such that the Field Representative does not have to enter the manhole to measure the thickness. One possible method would be to install pins (such as masonry nail) at four quadrants around the manhole spaced every 4 feet vertically. The pins would protrude slightly less than 1 inch from the wall. The lining would be installed to cover the pins, and the Field Representative could verify the thickness by checking that no pins are exposed without entering the manhole. The Contractor may develop other methods. The costs associated with measuring the liner thickness shall be included in the unit bid price. If the thickness of the lining is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to the Owner.

The Contractor shall visually verify the absence of leaks and perform a vacuum test. The Vacuum test shall be performed as follows:

- I. Vacuum Test - Test all rehabilitated manholes using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Vacuum testing will not be required on manholes with sewer lines greater than 16-inches in diameter due to safety concerns. Any visible leakage in the manhole or structure, before, during, or after the test shall be repaired regardless of the test results. Vacuum test shall be performed in accordance with ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum).

2220.12.3 Epoxy Manhole Monolithic Lining System (EMMLS). Field acceptance of EMMLS shall be based on the Engineer's evaluation of the proper monolithic lining of the manhole. Field acceptance shall also be based on the Engineer's evaluation of the appropriate installation and curing test data along with review of the manhole inspections.

The EMMLS shall provide a continuous monolithic lining with uniform thickness throughout the manhole interior. If the thickness of the EMMLS is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to the City.

The Engineer or City will measure the EMMLS cured thickness by physically cutting through the lining (by drilling or coring) and making a direct measurement. There will be up to two thickness measurement locations in each EMMLS manhole. A suitable non-destructive type of thickness measurement may also be used.

All the EMMLS thickness measurement locations shall be repaired by the Contractor in accordance with the manufacturer's recommendations. These repairs shall be included in the two year EMMLS guarantee.

The Contractor shall also perform in-place testing in each manhole to verify the adhesion of the EMMLS to the existing manhole substrate. Adhesion strength tests shall be in accordance with ASTM D7234 and the test area shall be isolated from the remaining portion of the manhole by coring through the liner into the substrate. Two tests shall be performed in each manhole at locations directed by the Engineer. Testing shall consist of a calibrated pull test. All equipment shall be provided by the contractor. Samples must meet a minimum pressure resistance of 400 psi.

There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in the EMMLS.

Contractor shall submit the proposed method for testing for these defects. One of the following tests shall be performed by the Contractor as directed by the City or the City's Agent

Vacuum Test: A vacuum test conforming to the requirements of ASTM C1244 shall be performed for every lined manhole or circular structure where practical.

Holiday Detection Test: A high voltage holiday detection system may be used to determine if any holidays (pinholes, voids, etc.) exist in the lining. Normally the sensitivity control of the holiday tester is set to accommodate the thickness of the applied lining (100-125 volts for each 1 mil thickness). Follow the guidelines of the holiday manufacturer for correct control settings. One such service is the Tinker & Rasor Holiday Tester Model APW.

Should a holiday be detected, it shall be marked and the lining installation contractor shall repair the void according to the correct procedure determined by the system manufacturer.

I. Ultrasonic Testing: Per ASTM D 6132.

2220.12.4 Cured-In-Place Manhole Liner (CIPM). Field acceptance of CIPM shall be based on the Engineer's evaluation of the proper monolithic lining of the manhole. Field acceptance shall also be based on the Engineer's evaluation of the appropriate installation and curing test data along with review of the manhole inspections.

The CIPM shall provide a continuous monolithic lining with uniform thickness throughout the manhole interior. If the thickness of the CIPM is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to the City.

The Engineer or City will measure the CIPM cured thickness by physically cutting through the lining (by drilling or coring) and making a direct measurement. There will be up to two thickness measurement locations in each CIPM manhole. A suitable non-destructive type of thickness measurement may also be used.

All CIPM thickness measurement locations shall be repaired by the Contractor in accordance with the manufacturer's recommendations. These repairs shall be included in the two-year guarantee.

The Contractor shall also perform in-place testing in each manhole to verify the adhesion of the CIPM to the existing manhole substrate. Adhesion strength tests shall be in accordance with ASTM D7234 and the test area shall be isolated from the remaining portion of the manhole by coring through the liner into the substrate. Two tests shall be performed in each manhole at locations directed by the Engineer. Testing shall consist of a calibrated pull test. All equipment shall be provided by the contractor. Samples must meet a minimum pressure resistance of 400 psi.

There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in the EMMLS.

Contractor shall submit proposed method for testing for these defects. One of the following tests shall be performed by the Contractor as directed by the City or the City's Agent.

1. Vacuum Test: A vacuum test conforming to the requirements of ASTM C1244 shall be performed for every lined manhole or circular structure where practical.
2. Holiday Detection Test: Per ASTM D4787, a high voltage holiday detection system may be used to determine if any holidays (pinholes, voids, etc.) exist in the lining. Normally the sensitivity control of the holiday tester is set to accommodate the thickness of the applied lining (100-125 volts for each 1 mil thickness). Follow the guidelines of the holiday manufacturer for correct control settings. One such service is the Tinker & Rasor Holiday Tester Model APW. Should a holiday be detected, it shall be marked and the lining installation contractor will repair the void according to the correct procedure determined by the system manufacturer.
3. Ultrasonic Testing: Per ASTM D6132

2220.13 MEASUREMENT AND PAYMENT. Measurement of work for payment of this item shall be on a Lump Sum (LS) basis per manhole lined. All rehabilitation work, as specified in Standard Specification Section 2210 or otherwise, performed in preparation to installing a monolithic liner shall be considered incidental to the installation of the liner system.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2220(1)	Monolithic Manhole Liner System	Each Manhole

SECTION 2300

SANITARY SEWER TESTING OF PIPES AND MANHOLES

2300.1 GENERAL. This section covers the testing of gravity sewers, sewer force mains, joints, and manholes or other materials incorporated into the sanitary sewer line to determine water tightness, leakage and alignment.

2300.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The most recent version of these references shall apply.

ASTM INTERNATIONAL (ASTM)

ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM C924	Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C942	Standard Test Methods for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C969	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM C1618	Standard Test Method for Concrete Sanitary Sewer Pipe by Negative (Vacuum) or Positive Air Pressure
ASTM D2412	Standard Test Methods for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3350	Polyethylene Plastics pipe and Fittings Materials
ASTM D3681	Standard Test Method for Chemical Resistance of Fiberglass (Glass Fiber Reinforced Thermosetting-Resin) Pipe in a Deflection Condition

ASTM D4414	Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM F679	Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	Standard for Installation of Ductile-Iron Water Mains and their Appurtenances
AWWA C605	Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings AWWA M9 Concrete Pressure Pipe

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
UNI-TR-1	Deflection: The Pipe/Soil Mechanism

2300.3 MATERIALS. All testing materials shall meet the requirements and shall be tested in accordance with the latest ASTM standard procedure for testing pipe, pipe joints, or other material. All pipe and pipe materials shall be subject to permeability and hydrostatic tests. All manholes shall be subject to a vacuum test.

2300.4 CONSTRUCTION.

2300.4.1 Leakage Tests for Gravity Sewers. All sewers shall pass leakage tests as specified herein before acceptance. All new sewer mains shall successfully pass low pressure air testing prior to connecting to the existing system. The leakage tests will be performed by the Contractor, in the presence of the City. The Contractor shall provide 24 hours notice to the City's Department of Water and Sewerage, so that the test can be scheduled.

After completing construction of each phase and prior to activating any service lines, sewer mains shall pass the low pressure air test. All pipe lines, associated laterals and fittings shall be in place prior to testing. The section of sewer line to be tested shall be flushed and cleared, by the Contractor prior to conducting the test. The section of sewer pipe to be tested shall be isolated by means of suitable test plugs. The ends of branches, laterals, tees, wyes, and stubs, that are to be included in a test section, shall be plugged to prevent water and/or air leakage.

All plugs shall be secured and braced to prevent blowout due to internal pressure. Gauges, air piping manifolds, and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure.

Existing groundwater, where it is known to exist, above the pipe invert shall be measured prior to any disturbance by installing a 1½ inch diameter standpipe. One foot of the pipe shall be slotted or screened and gravel packed to allow water to seek its natural level within the standpipe.

Low pressure air tests for sewer lines shall be performed in accordance with ASTM F1417. Air should be added slowly to the test section until the pressure inside the pipe is raised to 4.0 psig greater than the average back pressure of any groundwater that may submerge the pipe. After a pressure of 4.0 psig over groundwater back-pressure is obtained, the air supply should be regulated so that the pressure is maintained between 3.5 and 4.0 psig (above the average groundwater back pressure) for a period of two minutes to allow the air temperature to achieve equilibrium with the temperature of the pipe walls.

The rate of air loss shall be determined by "The Time Pressure-Drop Method". After the two minute air stabilization period, disconnect the air supply and adjust the pressure to 3.5 psig above the average groundwater back pressure. The time required for the test pressure to drop from 3.5 psig to 2.5 psig above the average groundwater back pressure shall be determined by means of a stopwatch and this time interval will be compared to the required time in the table to determine if the rate of air loss is within the allowable time limit. If the time is equal to or greater than the times indicated in the tables, the pipeline shall be deemed acceptable. If the test is unacceptable, the Contractor must find and correct the deficiencies in the line and re-conduct the test until acceptable time and pressure readings are achieved. Deficiency correction and retesting shall be at the Contractor's expense.

The portion of the line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psi (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following table based on ASTM F1417 Table I.

Pipe Inside Diameters in Inches	Test Time for 100 ft of pipe Minutes: Seconds
8"	7:34
10"	9:26
12"	11:20
15"	14:10
18"	17:00
21"	19:50
24"	22:40
27"	28:51
30"	35:37
33"	43:05
36"	51:17

Test time is based on 100 feet length of pipe. Test times listed above are minimums, and apply to shorter pipe runs as well. For longer pipe runs and other pipe sizes, the test time (T) in seconds shall be calculated by the formula:

$$T = 0.085 DK/Q$$

Where T is shortest time allowed for the air pressure to drop 1.0 psig, in seconds,
 K is 0.000419 DL but not less than 1.0
 Q is leak rate in cubic/feet/minute/square feet of internal surface = 0.0015 CFM/SF,
 D is measured average inside diameter of sewer pipe in inches, and
 L is length of test section, in ft.

Upon completion of the test, the air pressure in the sewer shall be bled off slowly and from the end of the test section opposite to the location of the test pressure gauge.

In addition to passing the above described leakage test, all obvious running leaks which may be observed in the final inspection shall be satisfactorily repaired.

2300.4.2 Manhole Air Vacuum Test. The Contractor shall vacuum test all manholes installed in gravity flow sanitary sewerage systems by using an inflatable compression band, vacuum pump and appurtenances specifically designed for vacuum testing manholes. Test procedures shall be in accordance with the test equipment manufacturer's recommendations and in accordance with the latest edition of ASTM C1244. Test equipment shall be provided by the Contractor and approved by the Engineer.

Manholes shall be vacuum tested after the manhole and connecting pipe have been completely installed. The test is to be witnessed by the City. All pipes entering the manhole shall be plugged, taking care to securely brace the plugs and pipe.

After the testing equipment is in place, a vacuum of ten inches (10") of Hg shall be drawn on the manhole. The manhole will be considered to have passed the test if it complies with the following table:

Manhole Depth (Ft.)	Maximum Allowable Pressure Drop (inch-of-Hg)	Time (Minutes)
0 - 10	1.0	2.0
10 - 15	1.0	2.5
15 - 25	1.0	3.0
25 - 35	1.0	4.0

If the manhole fails the initial test, the Contractor shall locate the point(s) of leakage, make the proper repairs, and retest the manhole until a satisfactory test result is obtained. Retesting and repairs shall be performed at Contractor's expense. In the event the initial test fails and retests are required, the Contractor shall pay for the City inspector's work time at his hourly wage rate.

After the trench area for the manholes have been backfilled, the cover frame casting sealed in place, vacuum tested, and prior to final acceptance of the project, a visual inspection of the inside of the manhole shall be performed to determine if any leaks have occurred. Any defective points in the manhole where leaks are occurring shall be repaired and the manhole made water tight and retested in accordance with this specification.

2300.4.3 Deflection Testing for Flexible Gravity Sewer Pipe. Pipe sizes 18" and larger shall require deflection testing. The City may require the Contractor to perform deflection test to any portion of the sewer line that he feels may have been distorted following the backfill operation. Locations with excessive deflection should be excavated and repaired by re-bedding and replacement of the pipe. Approved equipment to be used for testing includes a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. The maximum allowable pipe

deflection should be 3% to the base inside diameter. To ensure accurate testing, the lines must be thoroughly cleaned.

Mandrels shall have a diameter sufficient to allow the specified deflection in the inside base diameter of the pipe. Mandrels shall be manufactured to a maximum tolerance of +0.003 of an inch.

Any sewer main that has a deflection in excess of 5% shall be rejected. The Contractor shall remove all rejected pipe and replace it with new pipe, bedding and backfill sufficient to meet specifications at no additional cost to the City.

Prior to acceptance, the Engineer may require the Contractor to retest any portion of the system where the TV video camera indicates there may be a problem. Such testing shall be at no expense to the City. Prior to the expiration of the two (2) year maintenance period, the Department of Water and Sewerage maintenance crew may perform another deflection test to assure the pipe has not deformed during that period. If the pipe is deflected beyond manufacturer's specifications, the Contractor will be required to correct the deficiency.

2300.4.4 Pressure Test for Sewer Force Mains. Testing of sewer force mains shall not be started until the Engineer has reviewed and approved the test procedures. The Contractor shall provide 24 hours advanced written notice before commencing the test. Testing shall be performed after all piping has been installed, backfilled and temporary roadway surfacing has been placed.

Contractor shall test force mains using the hydrostatic pressure test method with clean water. Force main piping shall be divided into logical test sections based on valve and discharge locations. These sections shall be approved by the Engineer prior to testing.

Each section of main shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in accordance with the plans or the manufacturer's specifications. The pump, pipe connection, gauges, meters and other necessary equipment shall be furnished by the Contractor. While filling the pipe and before applying the specific test pressure, all air shall be expelled from the pipeline by means of taps at high points on the pipe run. Initially, the piping shall be filled only up to its working pressure, and then allowed to stabilize, and expand. The pipe manufacturer's recommendations for expansion times shall be followed during initial filling of the force main lines.

Following the expansion time, the individual sections shall be subjected to a hydrostatic test pressure of 1.5 times the working pressure of the pipe. The test pressure shall be maintained for at least two hours and shall be measured at the highest point along the test section. Testing allowance shall be per AWWA C600 requirements. Upon completion of the test, the pressure shall be bled off from a location other than the point where the pressure is monitored. Should any section fail this test, the Contractor shall, at his own expense, locate and repair or replace the defective item, and redo the test until the test pressure requirements are met.

Test results shall be submitted to the Engineer for approval with each partial payment request.

2300.4.5 Alignment Testing and Quality Checking of Gravity Sewer Pipe. Gravity sewer lines may be checked for quality work and alignment via use of video camera, at the discretion of the City. In addition, all gravity sewer pipe that have three (3) or more joints passing through casing pipe are to be 100% tested for alignment and grade (bows and sags) via use of a video camera, (See Section 1006).

For gravity sewer pipes vertical variation in the final position of the pipe from the grade shown in the plans may be tolerated only to the extent of 1/4-inch per 10 feet. At the Engineer's discretion, pipe installed by other than open cut methods, (jacking and boring), may be allowed horizontal variation to the extent of one (1") inch per ten (10') feet from line as shown on the plans.

A very minor bow in the casing pipe whether humped or sagged may be tolerated provided a continuous

downward slope of the casing pipe is maintained. No corkscrew or roller coaster pipe - no matter how slight - will be accepted. The casing pipe shall not deviate more than +/- three (3) inches off grade and one (1') foot off horizontal alignment. The City representative shall have final authority to accept or reject any pipe not installed on the line and grade.

Once casing is installed by boring or jacking, the Contractor shall video inspect the casing, in the presence of a City Inspector, to check the casing pipe for cleanliness (dirt clumps, tools, foreign matter, etc.), for correct assembly, (dangling seal rings, mis-connected joints, etc.) and for proper alignment before installing the carrier pipe into it. Video inspection shall be carried out by experienced, certified personnel. The Contractor shall use a camera capable of tilting, panning and zooming. The Contractor shall notify the City in writing, at least two working days in advance of the date on which the video test is to be performed. The Contractor shall partially fill the casing pipe with water and then drain it. The Contractor shall then video the casing, with the Contractor's site superintendent and the City Inspector present, to check for the items mentioned above and to verify if water has pooled in the pipe.

Gravity sewer casing pipe that has a sag or hump exceeding the dimensions mentioned above is unacceptable and must be replaced immediately at the Contractor's expense. Displacement of casing pipe extremities by force, to get it on line and grade, shall not be allowed and shall be rejected.

The bore will not be accepted until the carrier pipe meets the criteria stated above. Any follow-on work that is dependent upon having a good bore and which is performed prior to the bore being tested and accepted, is at Contractor's risk and expense. Any retesting by video inspection will also be paid by the Contractor.

2300.4.6 Testing of Rehabilitated Sewers and Manholes. Repaired/rehabilitated piping shall be subjected to leakage tests as specified in this section. The Contractor shall be responsible for isolating the repaired/rehabilitated section of the piping from the remainder of the piping. Contractor shall coordinate isolation of repaired/rehabilitated piping with the City.

After completion of any rehabilitation operation and backfilling (if required), the Contractor shall conduct the following tests on the manholes:

- a. Vacuum Test: Manhole shall be vacuum tested in accordance with Subsection 2300.4.2.
- b. Visual Inspection: The Engineer and Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired.

If an epoxy liner is applied, the following additional tests will be required:

- a. Wet Film Thickness Gage: During application, a wet film thickness gage meeting ASTM D4414 standards shall be used to verify a monolithic coating and uniform thickness during application.
- b. Adhesion Test: A minimum of 10% of the manholes coated shall be tested for adhesion/bond of the coating to the substrate. Testing shall be conducted in accordance with ASTM D7234.

2300.4.7 Final Acceptance. The Contractor shall conduct a final manhole-to-manhole inspection of the sewer system, in the presence of the City Inspector, to assure that it is clear of all foreign matter. The Contractor must re-flush and clean the line until it is completely free of all debris and foreign matter.

When the entire system has been cleaned and tentatively accepted by the Engineer, the system shall then be inspected by personnel of the Water and Sewerage Department using closed circuit television, prior to final acceptance of the manhole and sewer line. The digital video files shall be annotated as to manhole numbers and streets for easy identification.

2300.5 MEASUREMENT AND BASIS OF PAYMENT.

2300.5.1 Leakage Test for Gravity Sewers. Air Testing for Gravity Sewer Lines will be performed by the Contractor, in the presence of the City or their designated representatives. If the sewer main fails the test, the Contractor shall check the sewer to locate the defective area and to determine the cause or source of the leak. The Contractor shall repair or replace the defective material and/or workmanship. The Contractor shall repeat the test and perform video inspections, at no additional cost, until the sewer main meets the required specifications. No sewer main will be accepted or tied into the City system until it meets all the requirements specified above. Payment shall be included in the bid item for the installation of sanitary sewer pipe for the various sizes and depth.

2300.5.2 Leakage Test for Sewer Force Mains. Leakage testing of Sewer Force Mains shall be performed by the Contractor in the presence of the City or their designated representatives. Payment for this item shall be considered incidental to the installation of Sewer Force Mains and shall be included in the bid item for the installation of sewer force mains for various sizes, and depths. The Contractor shall repair or replace the defective material and/or workmanship. No sewer force main will be accepted or tied into the City system until it meets all the requirements specified herein.

2300.5.3 Vacuum Test For Manholes. Payment for this item shall be considered incidental to the installation of manholes and shall not be considered a separate bid item. Payment shall be included in the bid item for the installation of sanitary sewer manholes in the various types and depth categories.

2300.5.4 Deflection Testing. Payment for this item shall be considered incidental to the installation of sanitary sewer main and shall not be considered a separate bid item. Payment shall be included in the bid item for the installation of sanitary sewer pipe for the various sizes and depth.

2300.5.5 Alignment Testing. Payment for this item shall be considered incidental to the installation of sanitary sewer mains and shall not be considered a separate bid item. Payment shall be included in the bid item for the installation of sanitary sewer pipe for the various sizes and depth.

SECTION 2400

MANHOLE INFLOW PREVENTERS

2400.1 GENERAL. This section covers the installation of inflow preventers for sanitary sewer manholes. Manhole inflow preventers (inserts) prevent rainfall and other surface water from entering the sanitary sewer system through the cover pick holes and lid rings.

2400.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D1248

Standard Specification Polyethylene Plastics
Extrusion Materials for Wire and Cable

2400.3 CONSTRUCTION. The Contractor shall install plastic inflow preventers only on manholes with inflow and outflow sewer pipe sizes less than 21 inches in diameter and only on manholes not located in traffic bearing area. Stainless steel inflow preventers are required on all manholes subjected to vehicle traffic loads regardless of sewer pipe size.

The Contractor shall install the inserts between the lid and the frame of a sanitary sewer manhole. In addition, he will examine and check the one way diffuser vent valve on each insert to assure that it is functional and that it will allow for the release of sewer gases at not more than one psi above atmospheric pressure. The water leakage rate around the one way vent valve shall not exceed 10 gallons per 24 hours.

The Contractor shall clean and remove all dirt and debris from the manhole frame rim, prior to installation of the insert.

The insert shall be fully seated around the manhole frame rim to prevent water seepage. The gasket shall be coated with grease to aid in sealing and to prevent rust.

The security locking cable on the manhole insert shall be anchored to the manhole frame as shown on STANDARD PLAN No. 2200-6.

2400.4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT. Inflow preventers will not be measured or paid for separately but shall be included in the cost for manholes.

SECTION 2600

CURED-IN-PLACE WITHIN-A-PIPE

2600.1 GENERAL. The objective of rehabilitating an existing sewer pipe by means of a "Cured-In-Place" liner is to completely and effectively restore the integrity of the sewer pipe so that it is water tight along its entire length, to prevent water and/or roots external to the repaired pipe from accessing the sewer pipe either by inflow, infiltration or by root penetration.

This specification describes the method and process for furnishing all labor, materials, tools, equipment and incidentals necessary, to provide for the complete insitu rehabilitation of deteriorated sanitary sewer pipes, by forming a new water tight and snug fitting liner within the existing pipe. The installation of the cured-in-place within-a-pipe shall be by the "Inliner, USA", or "Insituform", "Perma-Liner", "RS Technik" process or an Engineer approved process.

These processes, in a typical and general form, consist of a flexible felt tube that is impregnated with an approved resin and is then inserted into an existing pipeline typically from a manhole through the interconnecting sewer pipe to a terminus manhole. Thereafter, the liner is heat cured into a hard impermeable pipe of the desired thickness providing a structural sound, uniformly smooth interior and tight fitting liner within the existing pipe.

2600.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Latest editions of the following standards shall be applied.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T99	Moisture-Density Relations of Soil using 2.5-Kg (5.5-lb) Rammer and a 305-mm (12-in) Drop

ASTM INTERNATIONAL (ASTM)

ASTM C581	Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service
ASTM D790	Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D5813	Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems
ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D3681	Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-

ASTM F1216

Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

ASTM F1743

Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION OSHA

29 CFR-1926

Safety and Health Regulations for Construction

2600.3 QUALITY ASSURANCE.

- A. The contractor performing the lining work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner. The contractor shall submit the following information for review and approval at the time of bid submittal:
 - 1. The number of years of experience in performing pipe lining projects.
 - 2. The name of the lining manufacturer and supplier for this work and previous work listed below. The Contractor shall be an approved installer as certified and/or licensed by the liner manufacturer.
 - 3. A list of municipal clients that the Contractor has performed this type of work
 - 4. The list shall contain names and telephone numbers of persons that can be contacted to verify previous satisfactory performance.
 - 5. A full description of the actual work performed.
 - 6. The list of municipal clients and description of the projects shall include the approximate linear footage (LF) of lining work completed. Provide a sufficient number of references to total 50,000 LF or more of lining work completed to date.
- B. The liner shall be provided by a single manufacturer. The supplier shall be responsible for the provision of all test requirements specified herein as applicable. In addition, all liners to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the City. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection will be the responsibility of the City.
- C. Relevant information from the manufacturer shall include, but may not be limited to, the specifications, characteristic and properties; ASTM C581 test results, and methods of applications. This data shall be submitted to the Engineer for approval prior to rehabilitation of the sanitary sewer. The Contractor shall also submit a written certification from the manufacturer that the material is suitable for its intended application. Said certification shall detail the curing temperature time schedule (i.e., time, duration and the required temperature at each stage of curing, including cool down). A separate certification letter must be submitted for each liner thickness, varying liner diameters, lengths etc. No variance

shall be allowed without written approval of the Engineer.

- D. Inspection of the liner may also be made by the City after delivery. The liner shall be subject to rejection at any time on account of failure to meet any of the requirements specified, even though sample liner may have been accepted as satisfactory at the place of manufacture. Liner material rejected after delivery shall be marked for identification and shall be removed from the job site at once.
- E. It shall also be incumbent upon the Contractor to adhere to the manufacturer's criteria, guidelines, and recommendations. A copy of the manufacturer's data sheet shall be made available to the Engineer. Any variance in the guidelines or recommendations after the Contract date shall require the Engineer's written approval.
- F. Any liner deemed "unacceptable" by the Engineer shall be replaced at the Contractor's expense and to the Engineer's satisfaction. The method of repair shall be approved in writing by the Engineer. Said approval shall require field and/or workshop demonstration(s).

2600.4 MATERIALS TESTING. This section references the ASTM Standards and Test Methods, which are herein incorporated as part of these Specifications. ASTM F1216 shall be the general guide for the previously mentioned pre-approved processes; although the City reserves the right to approve any material or installation practice which might differ from ASTM F1216.

No change or alteration during the course of the contract shall be allowed without the prior written approval of the Engineer. Physical properties of the approved resin components of the materials, as well as the cured liner, shall conform to the minimum structural values as listed below:

Tensile Strength	(ASTM D638)	3,000 psi
Flexural Strength	(ASTM D638)	4,500 psi
Flexural Modulus	(ASTM D790)	250,000 psi

Certified copies of all test reports on the properties of the selected resin, and on the liner coupons shall be submitted to the Engineer. Results of additional product testing(s), normally performed for "in-house quality control" and process improvement, shall also be provided to the Engineer, at no cost to the City.

The Contractor shall provide the Engineer a written schedule detailing the Name and Type of quality control test(s) and the sampling frequency of the tests on the resin and liner materials. The Engineer shall also have the right to require the testing to be done at designated liner location(s) within the scope of the contract

The City may also run tests on random samples, at no cost to the Contractor. When directed by the Engineer, the Contractor shall place a short test section of sewer pipe similar to the existing pipe, in the manhole to run the liner under restrained conditions, for later testing and thickness measurements, at no additional cost to the City. All test samples shall be labeled before shipment for testing. A duplicate piece shall also be provided to the Engineer, as directed, for inspection and/or testing by an independent laboratory.

2600.5 MATERIALS.

2600.5.1 Flexible Felt/Fiber Tube.

2600.5.1.1 Liner Tube Placed by Inversion. The flexible polyester fiber tube shall be manufactured and fabricated under quality control conditions set by the process manufacturer. It shall be sized so that when installed and cured, it shall snugly fit the internal circumference of the existing sewer pipe, and be free of folds, tucks or wrinkles. The required final minimum thickness, when cured with the liquid thermosetting resin, shall conform to requirements set forth in Section 2600.5.2. A data sheet detailing the physical characteristics and properties of the fiber tube shall be submitted to the Engineer. The total installation length shall be as necessary for the contractor, to effectively span the full length of sewer pipe between the manholes, plus any extra allowance as needed for proper stretching/shrinkage due to pressure, expansion, and/or for lateral service cuttings, etc.

2600.5.1.2 Pulled in Place Liner. Tubing for pulled-in-place liner shall utilize a combined fiberglass and polyester felt with sufficient needling, cross lapping, and unidirectional roving to yield a minimum break strength of 430 pounds per circumferential inch, free from tears, holes, cuts, foreign materials, and other defects. Tubing shall contain a dual fused lap seam which must be tested using ASTM D3035 at a nominal value of 68 lbs./linear-inch with no failure.

The liner film system shall consist of an inner nylon blended heat stabilized CTC #50/50HSP, or equivalent tubing of at least 5 mils thick through and over the fiber fabric tubing. The outer nylon blend heat stabilized, CTC #50/50HSP shall have engineered, oriented perforations.

The resin shall have a corrosion resistant polyester isophthalic, or a premium corrosion resistant vinyl ester which has excellent properties in an aqueous environment. The catalyst shall be compatible with the resin and the other components used in the manufacture of the liner. The resin shall be mixed with a sufficient amount of the catalyst to create a compound that will generate the required physical properties upon the cure. The compound shall also be able to cure in the presence of water and the absence of light. The saturated liner with uncured material shall have a minimum tensile strength of 350 lbs./inch, with the strain not being directly on the liner.

2600.5.2 Liner Properties. The thickness of the Cured-In-Place liner shall be based on the following physical conditions of the existing pipe.

1. All host pipes shall be classified as "partially" or "fully" deteriorated.
2. All pipes shall be subjected to a full soil load of 120 lbs./cf, with applicable Live Load and water table five (5) feet below the top of the ground.
3. Pipe roundness shall not deviate by more than 2% from ovality at the circumference unless directed by the City.

Based on physical conditions and design criteria previously specified, the required liner thickness shall be as detailed in the table below (thickness shall be rounded to the next highest multiple of 1.5mm after adding an allowance of 5% to the design thickness for resin migration). In any case the standard dimension ratio (SDR) for the liner shall be a minimum of SDR 35 up to sixteen foot (16') depth, and a minimum of SDR 25 up to twenty foot (20') depth.

Minimum Liner Thickness

Sewer I.D.	Pipe Invert <u>Depth 0'-15'</u>	Pipe invert <u>Depth Over 15'</u>
6"	4.5mm	6.0mm
8"	6.0mm	7.5mm
10"	7.5mm	9.0mm
12"	10.5mm	12.5mm
15"	12.0mm	13.5mm
18"	13.5mm	16.5mm
21"	16.5mm	19.5mm
24"	18.0mm	22.5mm

Diameters greater than 24" or depths greater than twenty (20') foot shall require special design by a Professional Engineer registered in the state of Louisiana.

The thickness of the cured-in-place liner shall not vary more than minus 5% or plus 10% of the designated thickness. Liner thickness greater than specified shall be unacceptable since hydraulic capacity of the sewer being rehabilitated would be reduced. Any liner that has been installed and cured, which does not meet the requirements of the specification, shall be removed and replaced at contractor's expense. The installed thickness shall be accurately measured and certified by the contractor.

2600.5.3 Resin. The liquid thermosetting resin used to impregnate the tube shall produce a properly cured liner which will be resistant to abrasion due to solids, grit and sand. The cured liner shall also be resistant to corrosion due to acids and gases such as sulfuric acid, carbonic acid, hydrogen sulfide, methane, and carbon monoxide. The resin shall be resistant to normal municipal sewage.

The resin system shall be manufactured by approved company(s) selected by the "Cured-In-Place" process manufacturer. Only corrosion resistant polyester and/or vinyl ester resins complying with the following definitions shall be used:

2600.5.3.1 Polyester Resin. A resin created by reaction products between isophthalic/terephthalic acid, a maleic anhydride and a glycol characterized by reactive unsaturation located in terminal position along the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce cross-linked copolymer matrices.

2600.5.3.2 Vinylester Resin. A resin created by reaction products of epoxy resins with methacrylic acid and characterized by reactive unsaturation located in terminal position of the molecular chain. This resin is compounded with a reactive styrene monomer and reacted together with initiators/promoters to produce cross-linked copolymer matrices.

The chemical corrosion resistance of the actual resin system (neat plus modifications) selected shall be tested by the resin manufacturer in accordance with ASTM C581. For those processes using a fiberglass felt composite, an additional strain corrosion test as set forth in ASTM D3681 shall be performed. Exposure to the chemical solutions listed below result in a loss of no more than twenty percent (20%) of the initial physical properties when tested in accordance with ASTM C581, for a period of not less than one (1) year. For applications other than standard domestic sewage, chemical resistance tests shall be conducted with actual samples of the fluid flowing in the pipe and in accordance with procedures approved by the City.

Chemical Solution	Concentration %
Tap Water (ph. 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Gasoline	100
Vegetable Oil	100
Detergent	0.1
Soap	0.1

It shall be incumbent upon the Contractor to adhere to the resin manufacturer's criteria, guidelines and recommendations. A copy of the resin manufacturer's data sheet shall be made available to the Engineer. Any variance in the guidelines or recommendations after the contract date shall require the Engineer's written approval prior to implementing any such variances.

2600.6 PRE-INSTALLATION PREPARATIONS. Property owners who discharge sewage directly into the sewer shall be notified about the construction and possible discontinued service while the liner is being installed. The notifications to each affected property owner shall be made at least 72 hours in advance of commencement of the work. The affected residents shall be notified of the date, start time and time when service will be completely restored.

Prior to the commencement of the actual liner installation process, all pipeline sections to be rehabilitated shall be cleaned in accordance with Section 2900. Existing relevant information (existing Closed Circuit Television (CCTV) inspection tapes and/or reports) regarding the pipeline to be rehabilitated will be provided to the Contractor. If such information is not available, it shall be the responsibility of the Contractor to conduct a CCTV preliminary inspection. Following this review, the Contractor is to prepare a log detailing the horizontal distance and the clock hour location of all service connections, breaks, cracks, dislocated pipe joints, root penetration, etc. Once the scope of repairs and work activities have been determined, the Contractor is to prepare and submit a project work schedule, seven (7) calendar days prior to the actual work, that details each work activity that is to be performed and the timing sequence for making the sewer line ready for liner installation and curing.

The Contractor is to prepare and submit a written procedure, project work schedule including a time schedule that details how all the service connections will be cut, tied-in, and made water tight. All required point repairs must be satisfactorily completed, equipment and material mobilized, and the Engineer shall be informed of the impending work schedules before beginning the liner installation.

Any section of the line that has a sag greater than 25% of its diameter or that has a reverse flow, shall be point repaired by the Contractor to correct the deficiency. The Contractor shall advise in writing as to the extent and cost of the point repairs to the Engineer for approval prior to commencing the work.

The Contractor is also to prepare a "Specialty Service Tie-in Schedule" that details each and every service connection that is to be cut and retied into the relined pipe.

2600.6.1 Safety. The Contractor shall carry out his operations in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the Contractor's responsibility to familiarize all involved personnel with OSHA Standards and Regulations pertaining to all aspects of the work and to assure that all manholes and sewer lines are adequately tested for harmful gases before beginning work in and around them. The Contractor shall have an "Emergency Action Plan" that details the equipment and materials needed to extract an unconscious person from a manhole. The Contractor shall assure that all required emergency response equipment is on hand and immediately available before beginning the work.

2600.6.2 Traffic Control and Barricade Plan. The Contractor shall prepare the site specific traffic control and barricade plan for each affected street in accordance with the applicable sections of this specification (See Traffic Barricade Manual Section) Standard Specification Section 1306.

2600.6.3 Pre-installation Cleaning. As specified earlier, the pipeline is to be cleaned in accordance with Section 2900 prior to pre-installation inspection, unless otherwise stated in the plans or by the Engineer. The cost of such cleaning shall be considered incidental to the work.

2600.6.4 Pre-installation Closed Circuit Television Inspection (CCTV). It shall be the responsibility of the Contractor to CCTV inspect the sewer pipe line after point repairs have been completed and immediately before the installation of the resin impregnated tube, to assure that the pipe is properly repaired, cleaned and pipe conditions have not changed. The Contractor shall have a camera capable of tilting, panning and zooming to identify and record all existing service lateral locations and indicate angles. Pre-installation CCTV tapes will become the City's property. The costs of this inspection, as well as the CCTV inspection after the installation, shall be incidental and shall be included in the cost of the linear. Inspection shall be carried out by experienced, certified personnel trained in locating breaks, obstacles, and service connections.

2600.6.5 By-pass Pumping. The Contractor shall furnish By-Pass pumping materials and equipment that are adequately sized to handle peak storm water inflow rates, (approx. 500% of daily average peak flow rates) for the particular sewage main that is being worked on. The pumping equipment shall be rigged with adequate muffler devices so as not to become a public noise nuisance, particularly if the equipment is to operate in residential areas. The Contractor shall also furnish additional signs and barricades as necessary to protect both the public and the work.

2600.6.6 Line Obstructions. If Pre-Installation CCTV inspection reveals an obstruction in the existing pipe line or a protrusion that extends one (1) inch or more into the line, which cannot be removed by conventional sewer cleaning and/or cutting methods, (such as heavy solids, dropped joints, protruding service connections or collapsed pipe which will hinder completion of the inversion process and/or could puncture a hole in the installed liner), then a point repair for obstruction removal shall be made by the Contractor, as per the provisions of relevant items in these Specifications, with the approval of the Engineer. Once point repairs have been completed, the Contractor shall confirm the ovality of the repaired line by running a mandrill through it. The liner ovality (true roundness) shall not deviate by more than 2% of the original inside diameter of pipe once it has cured in place.

2600.6.7 Sags in Sewer. If Pre-Installation CCTV inspection reveals a sag in the existing sewer line that is greater than one-quarter (1/4) of the diameter of the existing pipe, it shall be the Contractor's responsibility to install the liner pipe to result in an acceptable grade without the sag. The contractor shall take necessary measures to eliminate these by use of a point repair.

2600.7 INSTALLATION PROCEDURES.

2600.7.1 Wet Out. The Contractor shall designate a location where the fiber tube will be impregnated (wet out) with resin using calibrated distribution rollers and vacuum or pressure, to thoroughly saturate the fiber tube prior to installing it into the sewer line. Accurately calculate and measure the amount of resin required and thoroughly impregnate the fiber tube prior to installation. The Contractor shall provide the City a written copy of his "wet out" procedure and inform the Engineer at least 2 days in advance, to inspect the materials and the wet out process. The resin impregnated tube shall be transported to the job site and maintained at the specified temperature in a refrigerated truck. Only those catalyst systems and/or additive(s) that are compatible with the resin and tube, as recommended by the manufacturer may be used. The Engineer, at his option, may inspect the "wet out" for compliance with all applicable criteria. Said inspection shall not relieve the contractor of his responsibilities.

2600.7.2 Insertion. The resin impregnation tube shall be inserted into the designated point of entry by

inversion or pulled-in until it is properly installed between the upstream point of entry and point of terminus.

Using the "Inversion Procedure", the tube end shall initially be turned inside out, and attached to a platform ring or standpipe or another device as approved by the Engineer. Using the "Pulled-in Procedure", the impregnated liner shall be pulled through the insertion point of entry, through the sewer, to the terminus point by means of a winch assembly (a cable attached to the liner by a winch).

Water, air, or steam pressure will be applied and adjusted to sufficient force and pressure to cause the tube to completely invert. The pressure shall be held high enough to hold the impregnated tube tight against the wall of the pipe being lined and cause the resin to migrate into pipe joints, voids and defects. Alternatively the tube can be pulled into place and expanded by means of pressure with an inflated bladder.

The inversion pressure necessary for proper installation shall be provided by the manufacturer prior to installation. Tube installation forces or pressure shall be limited so as not to stretch the tube longitudinally or laterally by more than 5% of its length. The minimum pressure for inversion shall be maintained at all times during installation. In order not to damage the tube, the maximum pressure shall not be exceeded during the installation process. The maximum pressure shall be calculated and submitted to the Engineer prior to installation.

2600.7.3 Curing. After the liner is completed, the Contractor shall use a suitable heat source and re-circulation system to deliver the required amount of heat uniformly through the liner in order to assure a uniform cure of the resin. All water required for the initial liner installation shall be taken and metered from City fire hydrants as approved by the Director of Water and Sewerage Department. All water used shall be reported on the Contractor's daily activity report. Fire hydrants shall be operated only in the presence of a City Inspector. The cost of all water used for the initial installation shall be at the City's expense. The cost of water used to replace defective or rejected liners shall be at the Contractor's expense.

Curing temperatures and times shall be as recommended by the resin/catalyst system manufacturer. The Contractor is to provide the City Inspector a copy of the temperature curing schedule in advance of beginning the curing work.

The heat source shall be fitted with temperature gauges so the Contractor can monitor the temperature of the incoming and outgoing heat supply. Another temperature gauge shall be placed between the impregnated tube and the invert of the original pipe at the manhole(s) to monitor the outside liner temperatures during the resin curing process. The initial cure may be considered completed when the remote sensing device(s) indicates that the cure temperatures (have been achieved), as recommended by the resin/catalyst manufacturer. Curing temperatures and time durations and "cool down" time shall be as recommended by the resin manufacturer.

The installation and heating schedule/plan for each section (point of entry to terminus) shall be submitted within ten (10) days of the "Notice to Proceed". Temperatures shall be measured and recorded every ten minutes at both ends of the tube by accurate measuring devices that are calibrated to read in one (1°) degree increments. The initials of the City Inspector or an authorized representative shall be obtained; provided that he is present at the site. Copies of the curing temperature/time log sheet shall be submitted to the City within 24 hours of the completion of the curing process. It shall also be attached to the Contractor's daily activity report.

2600.7.4 Cool Down. The Contractor shall cool the hardened pipe to a temperature below 100 degrees Fahrenheit, in accordance with the resin manufacturer's recommendations, before relieving the water column or pressure. Cool water may be added to the water column while draining hot water from the small hole at the opposite end of the liner, so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column to avoid a vacuum that could damage or collapse the newly installed liner. Coupon samples shall be obtained and tested as specified earlier.

2600.7.5 Service Re-Connection And Sealing By Internal Remote Equipment. After the cured liner is installed in accordance with the plans and specifications, the contractor shall reconnect all active service lines. Abandoned service lines, which are predetermined by the City not to be reconnected, will be recorded by the Engineer. All active services to be reconnected, shall be precisely cut to within a half (1/2") inch accuracy of the center line of the service line by a remote internal cutting device as approved by the Engineer, and reconnected to a condition that does not inhibit flow.

The Contractor shall use a "Top Hat" for all service reconnections as described as follows:

The Top hat shall be an ECR (E-glass corrosion resistant) fiberglass laminate impregnated with an UV-light reactive Polyester resin which when cured is chemically resistant to domestic sewage over the expected life time of the rehabilitated pipe. The Top Hat shall be installed into the existing service lateral utilizing a pressure apparatus and ultraviolet light curing device positioned in the mainline pipe. The flexible fiberglass Top Hat tube insert shall be fabricated to a size that when installed will key into the internal surface irregularities of the lateral joint and neatly fit tight to the internal circumference of the lateral. The Top Hat tube shall be a laminate made of non-woven fiberglass materials that allow for circumferential stretching and angular alignment with the lateral pipe connection geometry during insertion. The insert laminate shall seal to the inside wall of the sewer main 3 (3") inches around the lateral opening and to the lateral wall six (6") inches up into the lateral pipe from the main. Unless otherwise specified, the installer shall furnish a specially formulated polyester resin and catalyst system compatible with the Cured-in-place process that provides cured physical strength at least to the same level as required for the lateral liner if specified. A secondary epoxy-sealing component shall be used to form a sealing bond between the Top hat and the host lateral and main pipe walls. The cured Top Hat shall conform to ASTM D790 with a minimum Flexural Modulus of Elasticity of 800,000 psi.

Services that exhibit deteriorated conditions and cannot be adequately reconnected internally, shall be excavated and repaired by materials approved by the Engineer. The minimum service length to be rehabilitated by internal remote control shall be twelve (12") inches.

Any service connections that are improperly cut (too large a hole, misaligned hole, etc.) shall be dug up and corrected and made water tight at the Contractor's expense. The minimum repair to such a lateral shall extend to ten (10') foot as necessary to satisfactorily render the service lateral to an operational condition.

Though it may be a licensed process, the Contractor or the franchisee shall not change any material, design values or procedural matters stated or approved herein, without the Engineer's prior knowledge and approval. Removal and replacement of fences, damage repair to yards, lawns, sidewalks, driveways, etc. due to movement of CCTV, cleaning, boiler, steam or other trucks and/or of equipment shall be incidental to the work.

No barriers, coatings, or any material other than the cured liner tube, are to be left in the host pipe. Any materials used in the installation, other than the cured liner tube are to be removed from the pipe. Remove any cured liner tube composite pipe left protruding from the service connection.

2600.7.6 Sealing at Manholes. The cured-in-place liner shall make a tight seal at the manhole opening with no annular gaps. Under all circumstances, a half inch (1/2") diameter activated oakum band soaked in Scotchseal 5600 or approved equal, shall be applied all around for a watertight seal, unless approved otherwise. All large annular spaces shall be sealed by using activated oakum soaked in Scotchseal 5600 or approved equal, and later covered with a cementitious mortar. This procedure shall be completed before proceeding to the next manhole to terminus line segment.

2600.7.7 Sealing Compound for Service Connection. The sealing compound shall be an epoxy capable of bonding with the liner and capable of forming an effective seal from the main to the lateral. Acceptable grout is an AV-118 as manufactured by Avanti International or approved equal. The sealing compound shall be placed by use of a remote device inside the main or the lateral.

2600.8 FINISHED PIPE. The finished cured-in-place liner shall be continuous for the entire length of

the host pipe from point of entry to terminus or manhole to manhole. It shall be free from visual defects, including foreign inclusions, dry spots, pinholes and delamination. The condition of the service re-connection shall be noted and recorded. A post-installation CCTV inspection shall be conducted by the Contractor, and a digital copy (DVD) of the inspection shall be provided to the City. During the Post-Installation CCTV, both the contractor and the City's Inspector shall review the tapes. If any defects are noted, the contractor shall immediately repair the defect at no cost to the City. Pressure testing the liner pipe shall be in accordance with Section 2300.

2600.9 CLEANING AND RESTORATION. Contractor shall restore excavated and disturbed areas due to insertion pit excavation or other disturbances to the immediate area. Backfill and compact excavation material to match the shape of the surrounding surface. Topsoil and seed shall be placed on the disturbed area, sod where needed. A Standard Proctor Test shall be carried out per applicable AASHTO T99 standards.

2600.10 WARRANTY. During the twenty-four (24) calendar month warranty period, any defects which affect the integrity or strength of the liner or hydraulic flow capacity shall be repaired at the Contractor's expense, in a manner acceptable to the City.

2600.11 POST CONSTRUCTION INFLOW & INFILTRATION TESTING. The Contractor shall check the inflow and infiltration adequacy and integrity of the service line and manhole connections by smoke testing or other acceptable methods as approved by the Engineer, once the work has been completed.

2600.12 MEASUREMENT AND BASIS OF PAYMENT. Cured-In-Place Within-A-Pipe shall be measured by linear foot from the centerline of manhole or point of entry to the centerline of the destination manhole or the point of terminus. The linear foot unit price bid for rehabilitating the sewer in the manner described, shall be full compensation for all materials, labor, equipment, testing, sealing and incidentals required to install the liner pipe within the sewer host pipe and to complete a sealed reconnected segment.

There shall be no separate measurement or payment for sealing the liner in the manholes, reworking the manhole inverts and benches, pressure testing the main, videotaping the line segment before or after, for the depth of the rehabilitation segment, for bypass pumping, cleaning of the pipes, etc. The unit price bid for service re-connection in the manner described, shall be full compensation for all materials, labor, equipment, and incidentals required to reconnect the laterals by remote within the sewer main. Pre-Installation and Post-Installation Television Inspection Videotaping and tapes; cleaning; sealing the liner at the manhole penetrations; bypass pumping; reworking the manhole inverts and benches; installing clean-out caps and concrete pads; shall not be measured or paid separately and shall be considered incidental to the cost of the liner. Rehabilitating the sewer laterals by remote in the manner described shall be considered incidental to the service re-connection.

Reconnection of the lateral services to the host pipe by remote shall be measured on a per each basis for each successfully reconnected service in the field. Rehabilitation of the sewer laterals by remote shall not be measured separately for lengths below twelve (12") inches.

Removal of protruding taps shall be measured on a per each basis. The basis of payment for removal of protruding taps per each in the manner described shall be full compensation for all materials, labor, equipment, and incidentals required to reconnect the laterals by remote within the sewer.

Pressure testing the liner pipe, in accordance with Section 2300, after installation shall not be measured, but shall be considered incidental to the cost of the project. The extra length wasted in the installation process shall not be measured separately, but shall be considered incidental to the work.

The basis of payment for point repairs shall be on a per linear foot basis for each diameter of pipe. The linear foot unit price for point repair of the existing sewer in the manner as described, shall be full compensation for all materials, labor, equipment, and incidentals required to re-establish the sewer on grade prior to installing the liner within the host sewer pipe.

All other payments shall be made as per bid items. No payment shall be made for work considered incidental or complimentary to a pay item already in the bid. The contractor shall clarify, for his own benefit, all work required for any item, incidental or otherwise, prior to bidding.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2600(1)	Cured-In-Place-Pipe (_ Diameter)	Linear Foot (LF)
2600(2)	Re-establishing Service Lateral	Each (EA)
2600(3)	Point Repair (_Diameter)	Linear Foot (LF)
2600(4)	Removal of Protruding Taps	Each (EA)

SECTION 2700

PIPE BURSTING

2700.1 GENERAL. Pipe Bursting is a method of replacing existing buried piping by installing a replacement pipe material into an existing host conduit. The actual pipe bursting shall be accomplished by means of inserting a tool/head of greater outside diameter than the maximum inside diameter of the existing host conduit, and which when advanced through the piping, fragments the existing host conduit and pushes the fragments into the surrounding soil. For the purposes of this specification Pipe Bursting refers to both Static and Pneumatic processes.

2700.2 SCOPE OF WORK. Furnish all labor, materials, equipment and incidentals required and install and test new restrained joint sewer line and appurtenances using pipe bursting as shown on the Drawings and as specified herein.

2700.3 REFERENCES.

The publications and references listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Latest editions of the following standards shall be applied.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron, Centrifugally Cast
AWWA C900	PVC Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm)

ASTM INTERNATIONAL (ASTM)

ASTM A536	Ductile Iron Castings
ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM D1248	Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D2657	Heat Fusion Joining of Polyolefin Pipe and Fittings

the Engineer.

2700.5 QUALIFICATIONS.

- A. The Pipe Bursting System Manufacturer shall have previously demonstrated its ability to have successfully installed a minimum of one (1) million feet of pipe via pipe bursting. Pipe Bursting System Manufacturers shall be TT Technologies, Inc., Aurora, Illinois; Miller Pipeline Corp., Indianapolis, IN or approved equal.
- B. The Contractor performing the work shall have at least two (2) years continuous experience in pipe bursting, and shall have completed at least three pipe bursting projects in the last five (5) years for a minimum of 3000 feet of 8 inch through 24 inch diameter piping. The Contractor shall submit the following information for review and approval at the time of bid submittal:
 - 1. The number of years of experience in performing pipe bursting projects.
 - 2. The name of the bursting equipment manufacturer and supplier for this work and previous work listed below. The Contractor shall be an approved installer as certified and/or licensed by the manufacturer.
 - 3. A list of municipal clients that the Contractor has performed this type of work for without defects or performance problems.
 - a. The list shall contain names and telephone numbers of persons to be called to verify previous satisfactory performance.
 - b. A full description of the actual work performed.
 - c. The list of municipal clients and description of projects shall include the approximate linear footage (lf) of lining work completed. The Contractor shall provide a sufficient number of references of bursting work completed to date.
 - 4. Pipe bursting personnel shall be certified by the manufacturer for having completed the following:
 - a. Operating a suitable bursting head.
 - b. Installing replacement restrained joint pipe.
 - c. Operation and maintenance of all associated pipe bursting equipment.
 - 5. HDPE/PVC fusion technicians shall be certified by the manufacturer of the fusing equipment for the following:
 - a. Fusion technicians shall have a minimum of five (5) years' experience with the fusion equipment used and shall be experienced in butt fusion and saddle fusion techniques.
 - b. Fusion technicians shall be experienced in the operation and maintenance of all associated fusion equipment.
- C. The Contractor shall also be capable of providing crews as needed to complete the work without undue delay and shall begin work from authorized notice to proceed.

2700.6 GUARANTEE.

- A. All work shall be fully guaranteed by the Contractor and manufacturer for a period of two years from the date of final completion. During this period, all serious defects discovered by the City shall be removed and replaced in a satisfactory manner at no cost to the City. The City may conduct an independent television inspection, at their own expense, of the lining work prior to the completion of the two year guarantee period.

2700.7 MATERIALS.

- A. Use pipe that is round with a smooth, even outer surface, and has joints that allow for easy connections between pipes. Pipe ends shall be designed so that bursting loads are evenly distributed around the entire pipe joint, and such that point loads will not occur when the pipe is installed. Pipe used for pipe bursting shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in-place loading conditions. Protect the driving ends of the pipe and joints against damage. HDPE liner pipe used shall have a Standard Dimension Ratio (SDR) of 17 unless otherwise noted herein or on the plans. The liner pipe shall be clearly marked as to brand, type, and SDR. DI piping shall be rated for a minimum pressure class of 250 psi. PVC liner piping shall meet the requirements of AWWA C900 and C905 as applicable.
- B. The pipe bursting equipment shall include a bentonite or polymer slurry lubrication system in accordance with the pipe bursting equipment manufacturer's recommendations, to reduce friction developed on the surface of the replacement pipe during insertion.
- C. Electrofusion couplings shall be manufactured by Central, Friatec, or approved equal.

2700.8 EQUIPMENT.

- A. The Pipe Bursting Contractor shall confirm proper selection of pipe bursting equipment which, based on past experience, has proven to be satisfactory for pipe bursting while maintaining accurate line and grade control. Equipment shall generally include a full bodied tool with rear expander, and constant tension winch or other method of monitoring correct cable tension.
- B. Sound emissions from the pipe bursting replacement process shall be limited to 80 decibels (dB) at 100-ft from the exhaust point of the pipe to be installed during the installation process. The Contractor shall measure noise and shall provide silencers or other devices to reduce equipment and work noise to meet these requirements.

2700.9 PREPARATION.

- A. Three working days prior to pipe bursting mains, the Contractor shall pothole all utility mains crossing the pipe bursting alignment to prevent damage to crossing utilities.
- B. All buried utilities adjacent to the pipe bursting operation shall be reviewed, and, where necessary, shall be excavated to relieve transient loading during the pipe bursting operation. If any utilities are considered by the contractor to be too close to the pipe to be burst, the Contractor shall excavate a pit at the location to check clearance. If adequate clearance does not exist between the existing sewer line and the subject utility, the Contractor shall employ substitute means to rehabilitate the existing sewer line. For utilities crossing near the existing sewer line to be burst, soil shall be excavated and removed to relieve loading during the pipe bursting operation.
- C. Potholed utility mains shall be fully exposed during pipe bursting to create a 6-inch minimum void space all around the crossing main. Void shall extend 1-foot on each side of pipe bursting. The Contractor is responsible for all costs resulting from damage to utilities

during pipe bursting operations.

- D. Any concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head. All in-line valves and fittings shall be removed prior to the pipe bursting operation.
- E. The Contractor shall provide bypass pumping of sewage flows in accordance with Section 2200. If sewage backup occurs and enters buildings, the Contractor shall be fully responsible for clean-up, repair, property damage costs and claims.
- F. The Contractor shall notify all property owners who discharge sewage directly into the sewer to be replaced, that their sewage service will be affected while the pipe is being installed. The Contractor shall notify each affected property owner at least two weeks in advance of commencement of the work, giving the date, start time and time when service will be completely restored. The Contractor shall notify the affected property owner a second time at least 72 hours prior to commencement of the work. The Contractor will also provide a telephone number which property owners can call for information during the work. The Contractor shall minimize the time period in which sewer service is disrupted.

2700.10 ACCESS PITS.

- A. The Contractor shall excavate pits at each end of the sewer segment to be burst. Pits shall be of sufficient size to allow access for bursting equipment and installation of new pipeline. All excavation shall be fully braced and supported in accordance with Sections 1004. Pits shall be centered over the existing sewer. Prior to conducting the work, the Contractor shall submit a plan to the Engineer showing the size and location of the proposed pits.
- B. The number of pits shall be the minimum number necessary to allow satisfactory completion of the work. The Contractor shall give consideration to the use of excavations required for other purposes such as service reconnection and manhole replacement as access pits for the bursting operation. Where manholes are used as machine or new pipe insertion pits, the Contractor shall modify, repair, and/or replace such manholes at no additional cost to the City.
- C. The Contractor shall keep all open excavations maintained and secured at all times with the use of barricades with lights, signs, construction tape or fencing, and/or by other means necessary or as directed by the Engineer.

2700.11 PRE-INSPECTION.

- A. The Contractor shall clean the host pipe in accordance with Section 2900, and conduct a videotaped CCTV inspection of each length of pipe to be burst. Contractor shall identify locations of sags, obstructions, offset joints, point repairs, and other factors that may limit the pipe bursting process.
- B. If pre-installation CCTV inspection reveals obstructions in the existing sewer (heavy solids, dropped joints, protruding service laterals, protruding utility lines, or collapsed pipe) which will prevent the completion of the pipe bursting process, and that cannot be removed by conventional sewer cleaning equipment, then an obstruction removal shall be made by the contractor with the approval of the Engineer. Obstruction removal shall be done by pipe replacement, digging an obstruction elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert, or by other measures as approved by the Engineer.
- C. If pre-installation CCTV inspection reveals a sag in the existing sewer that is greater than one-half the diameter of the existing pipe, it shall be the Contractor's responsibility to

install the replacement pipe to result in an acceptable grade without the sag. The Contractor shall take the necessary measures to eliminate these sags by pipe replacement, by digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert, or by other measures as approved by the Engineer.

- D. Notify Engineer in writing with appropriate documentation, if it is determined that pipe bursting may not be feasible.

2700.12 DISCONNECTING LATERALS AND SERVICE CONNECTIONS.

- A. Once all obstructions have been corrected, the Contractor shall dye test all service connections prior to bursting to determine all active service connections. A list of all service connections to be abandoned as part of the work shall be submitted to the Engineer for approval. The compiled list will include information on location of each service connection to be abandoned based on the television inspection logs.
- B. Prior to the actual bursting operation, the Contractor shall excavate and completely disconnect all service connections that are active.
- C. The Contractor shall expose the main at every lateral connection to a depth equal to the outside diameter of the main under the invert of the existing main to allow free movement of the bursting head. The lateral connection shall then be detached from the main and kept in service as specified herein.

2700.13 PIPE BURSTING.

- A. The pipe bursting shall be conducted in a continuous operation. Pipe bursting shall consist of pulling or pushing a specialized head through the pipe to be replaced which will simultaneously break up the existing pipeline and force the existing pipe and soil out while pulling the new restrained joint pipe behind the head. The bursting head shall be sized such that the maximum diameter of the tunnel created by the bursting operation shall not exceed the maximum outside diameter of the replacement pipe by greater than 3-in. The new sewer shall be installed straight along the centerline of the existing pipeline following the same line and grade. The upsizing method shall not cause excessive disruption or heaving to the above ground terrain.
- B. The Contractor shall provide pipe bursting equipment with adequate pulling/pushing force to enable completion of operation in a timely manner. The equipment shall be fitted with suitable appurtenances to measure the pulling/pushing forces exerted on the piping. Pulling/pushing forces shall not exceed manufacturer recommendations. Throughout construction, the Contractor shall be required maintain logs of such forces.
- C. Pipe bursting shall be implemented by pneumatic pipe bursting, or static pull technique, as determined based on field conditions, without interruption, from access pit/manhole to access pit/manhole. The replacement pipe shall be advanced directly behind the tool to fill the void left by the shattered host conduit.
- D. In cases of presence of existing utilities adjacent to the sewer to be replaced, the pipe bursting method shall limit vibrations transmitted to the surrounding soils. The peak velocity shall be limited to 0.5-in per second.
- E. In the event a section of pipe is damaged during the bursting operation, or joint failure occurs, as evidenced by inspection, visible groundwater inflow, or other observations, the Contractor shall submit to the Engineer for approval his methods for repair or replacement of the pipe.

- F. The Contractor shall allow the new restrained joint pipe to return to its original length and shape in the unstressed state and then trim the excess pipe in the manholes. The pipe manufacturer's recommendations shall be followed regarding the relief and normalization of stress and strain due to temporary stretching and elongation after pulling operations are completed. Time allowed for stress and strain relief shall not be less than 24 hours.

2700.14 WORK IN EXISTING MANHOLES.

- A. If existing manholes are utilized for pipe bursting operations, such manholes shall be prepared to allow of pipe installation activities. The invert shall be removed as required to facilitate pipe installation. Manhole inverts shall be replaced to their original condition or better at the conclusion of the operation, in accordance with the City's Standard Specifications and Standard Plans. Replace or rehabilitate any other damages to the manhole structure identified by the City's representative or Engineer.
- B. The Contractor shall install pulleys, rollers, bumpers, alignment control devices and any other equipment required to protect existing manholes and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.
- C. When the replacement pipe passes through an existing manhole or terminates at an existing manhole, the channel and portion of the base shall be chipped as deemed necessary by the Contractor in order for the bursting tool to be able to maintain a constant line and grade upstream and downstream of the manhole. The pipe within the existing manhole shall be neatly and completely sawcut off and not broken or sheered off, to protrude at least four inches away from the manhole walls. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Benches and channel cross section shall be reconstructed.
- D. If the pipe bursting tool and new pipe is planned to traverse the manhole without interruption during the operation, sewer pipe entrances and exits to manholes shall be modified to the appropriate dimensions. All required modifications to the invert shall be made before the replacement operations by the Contractor at no additional cost to the City and shall be considered incidental to the bid amount. Connections at existing manholes shall be enlarged before the bursting operation if the new pipe is planned to traverse through the manhole during bursting.
- E. All cutting and sealing of the new pipe at manhole connections shall provide watertight pipe and manhole trough seals. Connections to manholes will not be made any earlier than 24-hours following the bursting operations. It is intended that this 24 hour "relaxation period" will allow the pipe temperature to reach equilibrium with the surrounding soil and allow the pipe to release stresses imparted during bursting operations. Period shall be extended based on manufacturer's recommendations, if required.
- F. Sealing of the pipe at existing manholes shall not begin for a minimum of 24-hours after the line insertion. Provide a flexible gasket connector in the manhole wall at the end of the pipe, centered in the existing manhole wall. Grout the flexible connector in the manhole wall filling all voids for the full thickness.
- G. The replacement pipe in the manhole shall be locked down and sealed as specified above before proceeding on to the next manhole section and all manholes shall be individually inspected for replacement pipe cut-offs, benches, and sealing works.

2700.15 REESTABLISHING SERVICE CONNECTIONS.

- A. Pipe that is pulled into place shall be sufficiently relaxed prior to installation of temporary service connections. The relaxation period shall be as recommended by the pipe manufacturer, but in no case shall the period be less than one hour.
- B. All service laterals shall be permanently reconnected within 24 hours after the piping has been pulled in place, but not before the pipe has been allowed to relax a minimum of 12 hours.
- C. Connections to the existing service lateral pipe shall be made using flexible couplings. The slope of the existing lateral toward the newly installed sewer main shall be maintained at the existing percent. For reconstructed laterals, a minimum slope of two percent (2%) is required.

2700.16 POST-BURSTING.

- A. Upon completion of the pipe bursting operation the new pipeline shall be cleaned and tested in accordance with Sections 2100, 2300 and 2900, as applicable.
- B. Following installation of the new pipe and reinstatement of the service connections, the Contractor shall conduct a final videotaped CCTV inspection of the completed work. Two copies of these digital media shall be submitted to the Engineer for approval and shall be retained by the Engineer and the City.

2700.17 FIELD TESTING AND ACCEPTANCE.

- A. Field acceptance of the new pipeline shall be based on the Engineer's evaluation of the installation including CCTV digital media files.
- B. Groundwater infiltration of the liner shall be zero.
- C. All service connections shall be open, clear and watertight.

2700.18 MEASUREMENT AND BASIS OF PAYMENT.

- A. Piping installed by pipe bursting shall be measured by linear foot from the centerline of manhole or point of entry to the centerline of manhole or the point of terminus. The linear foot unit price bid for installing the sewer in the manner described, shall be full compensation for all materials, labor, equipment, testing, sealing and incidentals required to install the pipe by pipe bursting and to complete a sealed reconnected segment.
- B. There shall be no separate measurement or payment for sealing the piping in the manholes, reworking the manhole inverts and benches, pressure testing the piping, videotaping the line segment before or after, for the depth of the rehabilitation segment, for bypass pumping, cleaning of the pipes, etc. The unit price bid for service re-connection in the manner described, shall be full compensation for all materials, labor, equipment, and incidentals required to reconnect the laterals. Pre-Installation and Post-Installation CCTV taping; cleaning; sealing the liner at the manhole penetrations; bypass pumping; reworking the manhole inverts and benches; installing clean-out caps and concrete pads; and work on /connections to existing manholes shall not be measured or paid separately and shall be considered incidental to the cost of the operation.
- C. Reconnection of the lateral services to the host pipe by remote shall be measured on a per each basis for each successfully reconnected service in the field.
- D. Pressure testing the liner pipe, in accordance with Standard Specification Section 2300,

after installation shall not be measured, but shall be considered incidental to the cost of the project. The extra length wasted in the installation process shall not be measured separately, but shall be considered incidental to the work.

- E. The basis of payment for point repairs shall be on a per linear foot basis for each diameter of pipe. The linear foot unit price for point repair shall be full compensation for all materials, labor, equipment, and incidentals required to point repair operations prior to installing the pipe bursting operation.
- F. Existing areas disturbed due to pipe bursting operations shall be cleaned, and restored (site restoration) to their original condition or better. Site restoration includes, but is not limited to grading, fence replacement, lawns work, replacement of walkways, driveways, paving, etc. Site restoration and associated surface improvement shall be considered incidental to the work.

All other payments shall be made as per bid items. No payment shall be made for work considered incidental or complimentary to a pay item already in the bid. The contractor shall clarify, for his own benefit, all work required for any item, incidental or otherwise, prior to bidding.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2700(1)	Piping laid by Pipe Bursting (_ Diameter)	Linear Foot (LF)
2700(2)	Reestablishing Service Lateral	Each (EA)
2700(3)	Point Repair (_Diameter)	Linear Feet (LF)

SECTION 2800

PACKAGED SUBMERSIBLE LIFT STATION

2800.1 GENERAL. Furnish all labor, materials, equipment and incidentals required and install, place in operation and field test a submersible lift station that handles sanitary wastewater from sewer lines less than approximately 1200 gallons per minute, especially for private developments. The submersible lift station shall comprise of precast wetwell, constant speed submersible solids handling pumps, motors, guide rails, access hatches, valves, precast valve vault, flow meter, precast flow meter vault, control panels, control systems and appurtenances as specified herein. All stations shall contain at least two (2) pumps, each with 100% design capacity.

2800.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The most recent version of the references shall apply.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1200mm) for Water and Other Liquids.
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water and Other Liquids.
AWWA C500 Service.	Metal-Seated Gate Valves for Water Supply
AWWA C508	Swing-Check Valves for Waterworks Service, 2-in (50mm) Through 24-in (600mm) NPS.

ASTM INTERNATIONAL (ASTM)

ASTM A48 Castings	Standard Specification for Gray Iron
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
SSPC-SP6	Surface Preparation Specification No. 6 Commercial Blast Cleaning.

American Bearing Manufacturer's Association (ABMA)
American National Standards Institute (ANSI)
Hydraulics Institute (HI)
Joint Industrial Council Standards (JIC)
National Electrical Manufacturers Association (NEMA)

National Electrical Code (NEC)
Underwriters Laboratories (UL)

2800.3 QUALITY ASSURANCE. All the equipment specified herein shall be furnished by the pump station manufacturer and shall be products of manufacturers regularly engaged in the production of such equipment for over ten (10) years. The pump station manufacturer shall have the sole responsibility for the proper functioning of the complete packaged pumping station.

The pumps and other equipment covered by this Specification shall be standard production units of the manufacturers, currently available and listed in the respective manufacturer's catalog. The pumps furnished shall be in accordance with the Hydraulic Institute Standards and shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.

Controls shall not be assembled on site. System supplier shall be a UL 508 certified facility and shall be regularly engaged in the manufacture of controls for the municipal industry. The system specified herein shall be the product of a manufacturer having at least ten (10) years' experience in the construction of such control equipment.

2800.4 SUBMITTALS. The contractor shall provide five (5) hard copies of the following submittal / information for review and approval:

Shop and erection drawings showing all important details of construction, dimensions and anchor bolt installation requirements. Submittal shall demonstrate that hatch clear opening is sufficient for the pump supplied.

Descriptive literature, bulletins, and/or catalogs of the equipment. Sufficient data shall be submitted to document previous production of each pump model proposed for use on this Contract.

Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves based on actual factory tests of similar units, which show that they meet the specified requirements for head, flow rate, efficiency, NPSH, submergence and horsepower. Curves shall be submitted on 8-1/2-inch by 11-inch sheets, at as large a scale as is practical. Catalog sheets showing a family of curves will not be acceptable.

Structural calculations indicating that the wetwell, valve vault, and other precast structures can adequately withstand all applicable loads, stresses, and buoyancy. These calculations shall be performed and sealed by a Professional Engineer, licensed in the state of Louisiana.

The total weight of the equipment including the weight of the single largest item.

Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels and related systems.

Complete motor data, including, but not limited to:

1. Type of enclosure design
2. Rated horsepower
3. Rated voltage
4. Full Load Amps (FLA)
5. Starting current
6. Locked Rotor Amperes (LRA)

7. Locked Rotor Kilo Volt Amperes (LR KVA)
8. NEMA starting code letter and insulation code letter
9. RPM
10. Input power in kW at nameplate rating
11. Starting calculations
12. Cable size
13. Efficiency at 50%, 75% & 100% load, and power factor at 50%, 75% & 100% load
14. Speed torque curves
15. Recommended trip and alarm settings for temperature protective devices

A complete, total bill of materials of all equipment.

A list of the manufacturer's recommended spare parts (also see section 2800.5 of this specification), with the manufacturer's current price for each item. Include gaskets, seals, etc. on the list. List bearings by the bearing manufacturer's numbers only.

Certified agreement to the conditions of the warranty.

Submit description of factory test plan including test procedures and equipment.

Submit for approval certified test reports of factory testing and field testing.

Contractor shall provide five (5) hard copies and one electronic copy of record drawings and corrected shop drawings of the installation upon completion of the construction, but prior to final completion. Record drawings shall incorporate all changes and modifications effected. An additional full-size Record Drawing set shall be placed in the control panel. A waterproof reduced copy of the master "Record" wiring diagram shall be laminated in clear plastic and permanently fastened to the inside of the panel door.

In the event that the equipment offered does not conform to all of the detailed requirements of this specification, describe completely all nonconforming aspects. Failure to describe any and all deviations from the specifications will be cause for rejection.

2800.5 TOOLS AND SPARE PARTS. The contractor shall provide the following tools and spare parts:

Provide one set of all special tools as required for the proper servicing of equipment specified.

Provide one complete set of the manufacturer's standard set of spare parts, including at least the following spare parts for the pumping units.

1. Two complete sets of both radial and thrust bearings
2. Two shaft sleeves with keys, nuts and accessories
3. Two complete sets of wearing rings
4. Two sets of packing glands and pump seals complete with rings, nuts and bolts
5. Two sets of gaskets for each casing joint
6. Two sets of all special bolts, nuts and screws

7. One completely assembled rotating assembly

The following spare parts shall be furnished for the electrical system.

1. One box of control power fuses of each size furnished.
2. Two complete sets of starter contacts for every starter of each NEMA size installed.
3. Four starter coils for every starter of each NEMA size installed, if applicable.
4. Two sets of overload relay heaters of every size furnished, if applicable.
5. Two boxes of pilot lights.

Collect and store all spare parts in an area to be designated by the City. Furnish the Engineer with an inventory, listing all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.

Spare parts shall be packed in cartons, properly labeled with indelible markings with complete descriptive information including manufacturer, part number, part name and equipment for which the part is to be used and shall be properly treated for one year of storage.

2800.6 OPERATING INSTRUCTIONS. The Contractor shall provide five (5) hard copies and one electronic copy of Operating and Maintenance Manuals. The manuals shall be prepared specifically for equipment furnished and installed on this contract and shall include all required cuts, drawings, equipment lists, programming and controls descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

The Contractor shall include in his bid price the services of the equipment supplier's /authorized representative for two (2) separate site visits. The duration of these visits shall be as necessary to accomplish the following work. The first site visit shall be to inspect for proper installation, testing the installed equipment, and assisting the City during start-up.

The second site visit shall be to instruct the City's personnel for proper operation and maintenance of the pumps, valves and associated controls. Two separate training sessions shall be provided to accommodate the City's personnel work schedules. The Contractor shall coordinate testing, startup and instruction sessions between the City and the equipment supplier/manufacturer.

2800.7 WARRANTY. The manufacturer of the pump station shall guarantee it to be of quality construction, free from defects in material and workmanship for a minimum of two (2) years from the date of final completion.

The interior equipment, apparatus, and parts furnished shall be guaranteed for a period of two (2) years, excepting only those items that are normally consumed in service, such as light bulbs, oil, grease, packing, gaskets, O-rings, etc. The lift station manufacturer shall be solely responsible for the guarantee of the station and all components.

Major components, such as station structure, pumps, pump motors, etc., failing to perform as specified; or as represented by the manufacturer; or proven defective in service during the guarantee period, shall be replaced, repaired or satisfactorily modified by the manufacturer at no additional cost to the City.

2800.8 PRODUCTS. The material specified herein is intended to be standard equipment of proven ability and as manufactured by reputable concerns having experience in the production of such equipment. The equipment furnished shall be designed, constructed and installed in accordance with best practice and methods and shall operate satisfactorily when installed. It is implied that all named products and materials

listed herein shall include “or approved equal” at the end of each reference.

All equipment shall be designed and proportioned to have liberal strength, stability and stiffness and to be especially adapted for the intended service. All equipment and piping shall be rigidly and accurately anchored into position and all necessary foundation bolts, plates, nuts and washers shall be furnished and installed. All bolts, nuts, washers and other appurtenances shall be of 316 stainless steel.

2800.8.1 Wetwell. Wetwell shall be in compliance with the current revisions of the Great Lakes – Upper Mississippi River Board’s recommended standards, and Title 51, part XIII of the State of Louisiana’s Sanitary Code. Wetwell shall be precast concrete, circular in shape with a minimum diameter of 6 feet. Wetwell sizing, and associated clearances shall comply with the most recent version of the Hydraulic Institute (HI) standards.

The base slab of the wetwell shall be minimum 8 inches thick. The base of the wet well shall be grouted at the joints on the inside at a 1:1 slope to prevent the accumulation of solids. The wetwell invert shall also be wide enough to include adequate clearances between the pumps, and between the pump and the wall as detailed in the Hydraulic Institute Intake standards.

The wetwell cover shall be minimum 4 inches thick and shall consist of an opening of adequate dimensions to permit easy access/removal of pumps for maintenance. Access opening shall be a minimum of 24-inches in diameter or dimension. Additional wetwell access openings may be required as shown on the drawings. Aluminum access hatches capable of withstanding up to 300 psf live load shall be installed on the access opening. Access hatches shall be as manufactured by Halliday Products, Bilco or approved equal. The hatch frame and cover shall be flush with the top of the concrete complete with hinges and flush locking mechanism, upper guide holder and level sensor cable holder. Doors shall open and automatically lock with stainless steel “hold open” arm with aluminum release handles. Access hatches shall include a safety grate. An inverted “J” pipe or similar means for air ventilation shall be provided on the wetwell cover. The ventilation pipe shall be designed to allow an inflow of air at a rate equal to the maximum liquid pumping rate. Vent pipe shall be minimum 4-inches in diameter. Outside vent opening shall be furnished with a Type 316 stainless steel insect screen.

All seams, joints, openings and pipe penetrations shall be sealed watertight. Pipe penetrations shall be sealed using a modular seal as manufactured by Link-Seal or approved equal. Seals shall be made of suitable material to withstand the contents normally found in sanitary wastewater.

Pipe penetration holes shall be sized to accommodate the piping along with the modular seal. The Contractor shall coat concrete wetwell as specified in Section 2810, Wetwell Lining System. The entire wet well shall be sealed on the outside with two part urethane asphalt applied to provide a dry film thickness of 20 mils.

2800.8.2 Pumps And Appurtenances.

2800.8.2.1 Submersible Pumps. Pump stations shall consist of a minimum of two pumps of the same size, each capable of handling the design peak hourly flow. Pumps shall be non-clog, and capable of passing solid spheres 3-inches in diameter. Pump suction and discharge openings shall be minimum 4 inches in diameter.

All external pump and motor parts shall be of close grained cast iron, ASTM A48 Class 30 construction, with all parts in contact with wastewater protected by corrosion resistant coatings. Discharge connections shall be 125 lb. ANSI standard flanges. All external bolts and nuts shall be Type 316 stainless steel. Impellers shall be capable of passing rags and fibrous materials and shall be constructed of ASTM A536 Class 30 minimum ductile iron. Impeller key shall be Type 316 stainless steel. Impellers shall be dynamically balanced. Submersible pumps shall be manufactured by Gorman Rupp, Flygt or approved equal.

Each pump shall be provided with a balanced tandem mechanical shaft seal system. The upper (inner) of the tandem set of seals shall operate in a seal lubricant chamber located just below the stator housing. At a minimum, this set shall contain one stationary silicon carbide and one positively driven rotating carbon ring and shall function as an independent secondary barrier between the pumped liquid and the stator housing. The lower (outer) of the tandem set of seals shall function as the primary barrier between the pumped liquid and the stator housing. This set shall consist of a stationary ring and a positively driven rotating ring, both of which shall be either tungsten carbide or silicon carbide. Each interface shall be held in contact by its own Hastelloy-C® or Elgiloy® spring system or approved equal. The seal body shall be Type 316 stainless steel. The O-rings shall be FKM (Viton)® or approved equal, the seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. Seal design shall provide pressure applied to the outside diameter of the face. Shaft seals with conventional double mechanical seals containing either a common single or double spring acting between the upper and lower units are not acceptable or equal to the dual independent seal specified. Seals shall be manufactured by Chesterton, Crane or approved equal.

Pumps and motors shall be shop prepared and painted. Surface preparation shall be in accordance with SSPC-SP-10. Primer shall be one coat of 3.5 to 4.5 mil DFT epoxy, following which two coats of 4 to 6 DFT (per coat) epoxy paint shall be applied. Paint shall be by Tnemec, Carboline or approved equal.

2800.8.2.2 Motors. The pump/motor shaft shall be constructed of Type 416, 420 or Type 431 stainless steel. The shaft shall rotate on permanently lubricated ball bearings properly sized to withstand the axial and radial forces. The ABMA Minimum L-10 bearing life shall be at least 30,000 hours rated at the pump BEP.

The pump motor shall have cooling characteristics suitable to permit continuous operation in a totally or partially submerged condition. The pump motor shall be vertically mounted induction type, NEMA B design suitable for a 240 or 480 Volt, 3 Phase, 60 Hz, service, with a 1.15 service factor (combined). They shall have adequate starting torque and low starting current characteristics. That stator windings shall be insulated with moisture resistant Class H insulation rated for 180 °C (356 °F). That stator shall be insulated by trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. Each motor shall include a leakage sensor and a high temperature sensor to detect moisture and high temperature in the housing.

The motor shall not be overloaded beyond the nameplate rating at any point on the pump head capacity curve. The motor shaft shall be of adequate strength and stiffness for the service intended. Pump power cables shall be suitable for installation in Class I, Division I, Group D applications, cable sizes shall conform to NEC requirements for pump motors. Cable entry to the pumps shall be designed for immersed service.

On a case-by-case basis, the Contractor may request a variance from the 240 or 480 Volt, 3 Phase, 60 Hz, service requirement depending on the electrical service available.

2800.8.2.3 Appurtenances. The pump discharge elbow connection shall be permanently installed in the wetwell along with the discharge piping. Each pump shall be automatically connected and sealed to its discharge connection elbow when lowered into place.

Each pump shall be mounted on a sliding guide bracket which can be used to guide the pump into place. The discharge connection shall be bolted to the floor of the wetwell and shall be designed to receive the pump connection without any need for bolts or nuts. The discharge connection shall be attached to the floor by means of Type 316 stainless steel anchor bolts. Each pump shall ride on dual guide bars and shall be standard weight ¾-in Schedule 40 Type 316 stainless steel pipe.

Each pump shall be fitted with a Type 316 stainless steel lifting chain and a Type 316 stainless steel chain connector between the pump bail and chain. The lifting chain shall be rated for five times the pump weight (minimum). Unless noted otherwise, the lifting chain combined length shall be equal to the wet well depth

(top slab finished grade to wet well bottom) plus six feet to permit raising the pump for inspection and removal. The lifting chain shall be attached to a lifting bail on the pump. Eyebolts will not be considered as an acceptable alternate to a lifting bail.

Pressure transducers with float backups shall be provided for the control of the pumps and alarms, and floats shall be located such that they are not affected by incoming flow. Floats and level sensors shall be as specified below.

2800.8.3 Valve Vault, Piping And Valves

2800.8.3.1 Valve Vault. If a separate vault is required to house the valves, it shall be a poured concrete or pre-cast box with an approved aluminum access hatch with safety grating and steps, the same as for the wet well. Valve vault shall be sized appropriately to provide sufficient clearances, for removal and reinstallation of piping and valves. In no case shall valves be placed inside the wetwell. The entire valve vault shall be sealed on the outside with two part urethane asphalt applied to provide a dry film thickness of 20 mils.

Pipe penetrations shall be sealed using a modular seal as manufactured by Link-Seal or approved equal. Pipe penetration holes shall be sized to accommodate the piping along with the modular seal. The vault shall include a 2 ft. x 2 ft. square sump for accumulation and pumping of spilled fluids. The valve vault floor shall be sloped at 1% towards the sump to facilitate easy drainage into the wetwell. Aluminum checker cover plates shall be provided.

2800.8.3.2 Bypass Connection. The lift station's common discharge forcemain header shall include a bypass arrangement to facilitate operation during times the pump(s) or the forcemain is not functioning. The bypass arrangement shall be located inside of the valve vault/enclosure. Piping and valves shall be the same size and material as the common discharge forcemain and shall meet all pertinent requirements specified herein. The bypass piping shall include a vertical 90 deg bend, spool piping of appropriate length, a shut off valve, and shall terminate with a male disconnect fitting.

2800.8.3.3 Ductile Iron Piping. Discharge lines from the pumps shall be minimum 4 inches in diameter to convey sanitary sewer flows at a minimum velocity of 3 fps. Piping shall be ductile iron pipe, and shall conform to the physical and chemical requirements of AWWA C151 and shall have dimensions and wall thickness for a minimum pressure of 250 psi. Fittings shall be ductile iron or cast iron conforming to AWWA C110, 150 psi minimum pressure rating.

Flanged discharge piping shall be used in the vault, and shall be in conformance with AWWA C115, and shall be suitable for the maximum expected discharge pressures. Flanged joints shall be with factory applied screwed 125 lb. long hub companion flanges conforming to ANSI B16.1. Flanges shall be faced and drilled after being threaded to pipe, be true 90 degrees with the pipe axis and shall be flush with the end of the pipe. Flanged pipe shall be cut true to length. Ring gaskets shall be rubber with cloth insertion. Gaskets shall be 1/16-in thick.

Buried ductile iron piping shall use restrained mechanical joints and shall be polywrapped in accordance with Standard Specification Section 209.

Coatings for pipe and fittings shall be in accordance with Specification Section 209. Piping shall be properly supported in the vault.

The piping shall be joined into a single restrained forcemain immediately outside of the valve vault, by means of 90 degree bends or wye fittings.

2800.8.3.4 PVC Piping. All PVC service (not force main) piping, unless noted otherwise, shall be Schedule 80.

2800.8.3.5 Valves. Check valves shall be swing type with lever arm and adjustable weights and shall

meet the material requirements of AWWA C508. The valves shall be iron body, bronze mounted, single disc, 150 psi working water pressure, nonshock and hydrostatically tested at 300 psi. Ends shall be 125 lb. ANSI B16.1 flanges. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and spring. Springs with various tensions shall be provided. Swing check valves shall be as manufactured by Val-Matic, Pratt, Dezurik or approved equal.

Plug valves with lever actuators shall be of offset disc type, 1/4 turn, non-lubricated, serviceable (able to be repacked) under full line pressure and capable of sealing in both directions at rated pressure. Disc shall be completely out of flow path when open. Plug valve bodies shall be of cast iron, 30,000 psi tensile strength, ASTM A 126, Grade B, or of ductile iron, ASTM A 536 and of top entry, bolted bonnet design, cast with integral flanges conforming to connecting piping. Exposed bolts, nuts, and washers shall be zinc or cadmium-plated, except for submerged valves, which shall have Type 316 stainless steel hardware. Plug valves specified herein shall be manufactured by DeZurik, Pratt or approved equal.

Air release valves, suitable for sewer service, shall be installed downstream of the swing check valves or per the Engineer's direction. The small orifice air release valves shall be furnished with reinforced nylon and stainless steel body. Discharge from the air release valves shall be directed to the wetwell. The float ball shall be constructed of foamed polypropylene and attached to a stainless steel rod. Float ball hangers shall be provided for all float ball assemblies, hangers shall be Type 316 Stainless Steel. Air release valve installations shall include schedule 80 PVC purge lines that terminate 6 inches above the floor of the valve vault. Air release valves for sewer service shall be as manufactured by A.R.I. or approved equal.

Valves shall be located in dedicated vaults/enclosures. Valves shall not be located inside the wet well.

2800.8.3.6 Pressure Gauges and Transmitters. Each discharge line in the valve vault shall be fitted with a pressure gauge. Pressure gauges shall be bronze bourdon tube Ametek U.S. Gauge, SOLFRUNT Duragauge Series 1980 Black Phenol Turret type with Type 316 stainless steel rack and pinion movement or approved equal. The gauges shall be glycerin filled. Gauges shall range from 0 psig to a minimum of 25 percent over the maximum expected head. Gauges shall be 4-1/2-in diameter, furnished with 1/4-in inlet. All fittings and cocks shall be Type 316 stainless steel. Pressure gauges shall be furnished with isolating pulsation dampers. Diaphragm seals shall be Teflon coated, oil filled, Type 316 stainless steel suitable for use with pressure gauges. When pressure transmitters are required or specified, they shall be Siemens or approved equal. Pressure transmitters shall be capable of operation in the process temperature range of -20⁰ C to 80⁰ C. Output signal shall be 4-20 mA DC with HART protocol, linear with pressure. Pressure transmitter shall be housed in a NEMA 4X, explosion proof enclosure, approved for Class I, Division I, Groups C and D. Isolating diaphragm and other wetted metal parts shall be 316 Stainless Steel. Gaskets and O-rings shall be Teflon. The sensor fill fluid shall be silicone.

2800.8.4 Motorized Jib Crane. When specified in the contract documents, Contractor shall provide a jib crane for pumps weighing 1.5 Tons and above. Jib cranes shall be motorized, free standing pillar type, base plate mounted, bolted to the concrete structure. Jib Crane rated capacity shall be 2-times the weight of the largest pump. The jib crane shall consist of a motorized horizontal boom mounted on a heavy wall structural steel pipe, with wall thickness sized for minimum deflection. The mast shall have a large diameter base plate reinforced with heavy steel gussets for continuous alignment and stiffness. The crane head section shall be a rigid steel plate box type welded construction for minimum deflection between the boom and mast. The head section shall house the motor, and provide a weather protected enclosure for the associated bearings and rollers supporting the boom. The boom shall rotate a full 360 degrees on a Timken or approved equal tapered roller bearing, providing full capacity vertical and radial thrust loading. The lower section of the head shall revolve around the mast on a pair of steel rollers equipped with self-aligning roller bearings. Rollers shall be adjustable to level the boom. All bearings shall be easily accessible for lubrication. The jib crane boom shall be a rolled steel I-beam section reinforced as required, with long wearing tapered flange for smooth trolley travel. End stops shall be provided to limit trolley travel at both ends of the boom. The entire unit shall be designed to meet or exceed the requirements of AISC and for

outdoor installation.

Each jib crane shall be furnished with a motorized trolley. Trolley shall be 4-wheel type, with hardened steel wheels supported on combination radial and thrust anti-friction pre-lubricated bearings. The jib crane shall be primed and finish painted in the manufacturer's shop. Surface preparation and painting shall be suitable for outdoor installation. A jib crane shall be provided when shown on the drawings.

2800.8.5 Pump Controls (Duplex Stations Or Above). The systems integrator should be located within a maximum of 150 mile radius of the City. The systems integrator shall have a minimum of 10 years' experience in designing, testing, building and installing control panel and/or systems for submersible lift stations. Experience on similar work other than lift stations will not be considered equivalent. Replacement parts and equipment for the entire control system are to be in stock at all times by more than one local supplier within 30 miles of the City. The City's lift station personnel are currently licensed and trained for "Siemens Portal V12 or Higher", any other software to be used must be pre-approved and all license keys, development software and training (minimum of 40 hours) by the manufacturer's certified Engineer with a minimum of five (5) years' experience shall be included. The systems integrator that will be working on the City's SCADA (located at Lucas Wastewater Treatment Plant) system shall be Citect certified (in Configuration). Citect certification shall be submitted along with the Controls System submittal. Prior to implementation of the controls system, the systems integrator shall spend a minimum of 40 hours with the City's Lift Station staff to discuss the controls system in detail.

Pump station controls shall be per the Engineer's controls specifications.

2800.8.5.1 Control Panel. The control panel shall be NEMA 4X stainless steel construction and shall be located adjacent to the wetwell. The control panel assembly, and level instruments shall be UL labeled for industrial control panels in accordance with UL-508. Power supply to the pump control panel will be 240 or 480 Volt, 3 phase. Provide an individual thermal magnetic circuit breaker/disconnect switch interlocked with the door handle.

The control leads to and from the wetwell shall be low voltage, microwatt type designed to not exceed their normal voltage or current values due to system component failure. The panel shall include lamacoid nameplates, and the following displays, switches and alarm lights. The information listed below (A through D) is applicable for small lift stations (<15 Hp) with a new radio system. For other lift station scenarios (medium and large lift stations) and radio scenarios (existing Motorola radio or new radio) refer to the controls specifications.

- A. Panel Mounted Lights and display for the indication of:
 - 1. High Motor Temperature Alarm (per pump) – Yellow Light
 - 2. Motor leakage Alarm (per pump) – Yellow Light
 - 3. High Water Level Alarm – Red Light
 - 4. Pump Failure Alarm (per pump) – Yellow Light
 - 5. Pump Hour Meter
- B. Panel Mounted Switches :
 - 1. Hand/Off/Auto switch (per pump)
- C. Isolated signals and dry contacts to interface with the SCADA system:
 - 1. Pump Running (Discrete Output – per pump)

2. Pump Failure Alarm (Discrete Output – per pump)
 3. High Water Alarm (Discrete Output)
 4. Wetwell Level (4-20 mA signal)
 5. Power Failure
 6. Low Level
 7. High Sump Level (where applicable)
 8. Pump Off
 9. Door Security Alarm (where applicable)
- D. Panel mounted push buttons
1. Alarm Horn Silence
 2. Pump Failure Reset

The control panel shall communicate with the City's SCADA system through a radio connection depending on the location of the pump station and the City's preference. The Contractor shall coordinate with City to integrate lift station controls into the SCADA system.

2800.8.5.1.1 PLC. PLCs where required, shall be as manufactured by Siemen's or, Square D, with a 50 KB memory dedicated for user data, and 10 KB dedicated to retentive data. PLC shall include 1024 KB inputs and 1024 KB outputs and shall be completely programmed prior to shipment. PLC shall include TCP/IP connectivity to communicate with the Citect system.

2800.8.6 Electrical.

2800.8.6.1 Control Panel Enclosure. Control panel enclosure shall be constructed from 12 gauge 316 stainless steel with a #4 finish. All hardware on exterior of panel shall be stainless steel. Exterior door shall be held shut with pad lockable, 3-point door latch by Austin, or approved equal. The padlock is to be provided by the City. Inner door shall be held shut with latch, Emka wingknob and cam, or approved equal. All doors shall be mounted to the enclosure with continuous hinges. Exterior door shall be gasketed to provide a watertight seal to the enclosure. Subpanel and inner door shall be 12 gauge mild steel primed and painted white. All control switches, pushbuttons, elapsed time meters, and indicator lights shall be mounted on or through the inner door. All panel wiring and equipment layout shall be performed per NEMA and JIC specifications. NEC gutter spacing shall be observed. A minimum of 6 inch additional D.I.N. rail shall be provided for future mounting expansion.

2800.8.6.2 Power Distribution Block. Provide a main power distribution block sized for incoming power to the panel. Each pole of the block shall be supplied with a clear cover for operator protection. Power distribution block shall be by Ferraz Shawmut or approved equal.

2800.8.6.3 Surge Suppression. Provide a silicon oxide varistor surge/lightning suppressor connected to the power distribution block and sized for incoming voltage. Minimum ratings shall be 60,000 amps, 1500 Joules. Suppressor shall be by General Electric, Westinghouse or approved equal.

2800.8.6.4 Phase Monitor. Where three-phase motors are controlled, provide a plug-in style phase monitor designed to monitor phase loss, under voltage, and phase sequence with a SPDT contact to interrupt all control power in the event of phase loss. Phase monitor shall be supplied with fused protection of the three phase sensing circuit. Phase monitor shall be Diversified Electronics SLA series, or

approved equal. Fuseholder shall be three-pole Ferraz Shawmut, or approved equal. Fuses shall be fast-acting as manufactured by Ferraz Shawmut, or approved equal.

2800.8.6.5 Circuit Breakers. Provide individual, properly sized, thermal-magnetic circuit breaker for each load served. Combination circuit breaker and overload mechanism shall not be allowed. Circuit breakers for motors and other loads shall have a minimum rating of 10,000 AIC (230 VAC breakers) or 14,000 AIC (480 VAC breakers).

Provide individual, properly sized, thermal-magnetic circuit breaker for each of the following:

- A. Transformer
- B. Each motor load

Provide 1-pole, 20-amp circuit breakers for the following loads:

- A. Control circuit
- B. Panel receptacle/condensation heater/service light.

2800.8.6.6 Contactors/Overload Relay. A magnetic across the line horsepower/current rated motor contactor with ambient temperature compensated overload relay shall be provided for each motor load served. Contactor shall be by Cutler Hammer, ABB, or approved equal. Overload relay shall be Cutler-Hammer, ABB, or approved equal.

Large lift stations (pumps 25 HP and larger) shall be provided with a variable frequency drives (VFDs) (with overload protection), and bypass capabilities for each motor load served. VFDs shall be Siemens, or Square D.

2800.8.6.7 Transformer. A 120 and a 24 volt control circuit transformer with fuse protection shall be included. If 120 volt, single phase is not available, a minimum 2KVA dry-type transformer shall be supplied with primary and secondary short circuit protection. Control power shall be 120 volt. Control circuit shall be connected so that a power outage of any duration does not require manual re-start of system.

2800.8.6.8 Fuseholders and Fuses. Provide a fuseholder and fuse for the control circuit, minimum rating 5 amps (ampacity not to exceed relay contact rating). Fuseholders for control fuses shall be finger safe with neon light indication for a blown fuse. Control fuse fuseholders shall be Ferraz Shawmut, Entelec, or approved equal.

2800.8.6.9 Terminal Blocks. Numbered terminal blocks shall be supplied for all field terminations. Current capacity of terminal strips shall be equal to the load served. Terminal blocks shall be suitable for minimum 12 AWG wire at not less than 300 volts. Terminal blocks for control interface shall be by Entelec or approved equal.

2800.8.6.10 Interior Service Light. Provide an interior 1600 lumens LED light bulb w/ safety lens fastened to the top of the enclosure with two-position "Off-On" selector knob to control. Incandescent light fixtures shall not be acceptable. Light shall be mounted without penetrating the panel outer skin with screws or fasteners.

2800.8.6.11 Entry Switch. An entry switch shall be mounted in the panel, which shall close a contact wired to the telemetry unit when the exterior door of the enclosure is not closed. Switch shall be by Microswitch or approved equal.

2800.8.6.12 Receptacle. Provide a 20-amp G.F.I. duplex receptacle connected to a separate circuit breaker, as described elsewhere, and mounted on the control panel inner door.

2800.8.6.13 Temperature Control. The control panel shall include an exhaust system to maintain a temperature below 105 degrees F. The exhaust system shall include an exhaust fan and appropriately sized air intake. Exhaust fan motors shall operate on 120 V, 60 Hz power and shall consist of an integral thermostat. Inter air conditioning system shall be provided for pumps operated on VFDs.

2800.8.6.14 Condensation Heater. Provide a 100 watt, 120 VAC silicone rubber self-adhesive condensation heater mounted on a flange with integral 40 degree thermostat. Heater shall be as manufactured by Watlow or approved equal.

2800.8.6.15 Alternator (If applicable). Provide an automatic electronic alternator for alternating pump operation on successive automatic cycles. Relay shall incorporate LED position indicators and a toggle switch to select pump #1 or pump #2 as the lead pump, or to allow automatic alternation. Alternator shall be by Autocon Industries or approved equal.

2800.8.6.16 Relays (If applicable). Relays shall be general purpose plug-in relays with standard mounting configurations. The relays shall have the number of poles as shown on the drawings with neon indicating lamp and test button integral to each relay. Relay contact ratings shall be minimum 5 amps.

2800.8.6.17 Time Delay Relays (If applicable). Time delay relays shall be dial or D.I.P. switch selectable, and shall have contact ratings of not less than 10 amps. Switch settings shall be labeled on the relay. Time delay relays shall be by General Electric, or approved equal.

2800.8.6.18 Selector Switches and Pilot Lights. Selector switches and pilot lights are not required at locations that include a touch screen HMI. Selector switches shall be 30 mm oil tight type with lever operators and 10 amp contacts. Knob operators shall not be accepted. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 VAC and 10 amps. Control switches shall be Cutler-Hammer or approved equal. Contact blocks shall be Cutler-Hammer or approved equal. The following selector switches shall be included (per pump where applicable):

- A. Hand/Off/Auto
- B. Pump Selector with Auto option (Ex: Pump 1, Auto, Pump 2)

Pilot lights shall be push-to-test, oil-tight industrial units utilizing 120 volt bulbs (unless otherwise specified). Lenses shall be colored as shown on the drawings. Control panel lights shall be modular construction as manufactured by Cutler Hammer or approved equal. Contact blocks shall be Cutler-Hammer or approved equal. LED type lights shall not be acceptable. Provide pilot lights for the following functions (per pump where applicable):

A. Pump Off	Green
B. High Level	Red
C. Pump Run	Red
D. Motor Overload	Amber
E. Pump Seal Fail	Amber
F. Pump High Temp.	Amber
G. Backup Float Ball Mode	Red

2800.8.6.19 Pushbuttons. Pushbuttons shall be oil-tight industrial units. Contact blocks shall be provided as required and shall be rated for a nominal voltage of 500 VAC and 10 amps. Control panel pushbuttons shall be modular construction as manufactured by Cutler Hammer or approved equal. Provide push-buttons for the following functions:

- A. Alarm horn silence
- B. Pump Fail Reset
- C. Backup Float Ball Reset

2800.8.6.20 Elapsed Time Meters. Provide an elapsed time meter for each pump. Meter shall be 6-digit, non-resettable, reading in hours and tenths of hours. Elapsed time meter shall be by Eagle Signal, General Electric; Westinghouse or approved equal.

2800.8.6.21 Seal Fail Relay. Provide a conductance actuated moisture sensing relay for each submersible pump controlled with field adjustable sensitivity. Specialized relays/sensors, if required by the pump manufacturer, shall be supplied to the panel manufacturer by the pump manufacturer prior to panel construction. Seal Fail Relay shall be Diversified Electronics, Syrelec, or approved equal.

2800.8.6.22 Alarm Light. Provide a red strobe light mounted to the top, exterior of the enclosure. Minimum ratings shall be 1.5 Joules at 70 flashes per minute. The strobe light shall be fully sealed to prevent water from entering the enclosure and be attached by mounting screws from inside the enclosure to prevent tampering.

2800.8.6.23 Ground Buss/Lugs. Provide a ground lug sized for incoming power ground near the power distribution block. Provide a ground lug sized for pump ground near pump power wire terminations. Provide a ground buss for control equipment grounding, minimum 6 termination points.

2800.8.6.24 Corrosion Inhibitor. Provide a corrosion inhibitor mounted inside the control panel. Corrosion inhibitor shall be Hoffman or approved equal.

2800.8.6.25 Wiring. Power distribution wiring on the line side of panel fuses or circuit breakers shall be sized for the load served, minimum 12 AWG, Control wiring shall be minimum #16 gauge SIS type stranded wire for internal control panel circuits. All control wires shall be numbered at each termination corresponding to the master wiring diagram with clip-sleeve or heat-shrink type wire markers. Wrap-on or adhesive wire markers shall not be allowed. All color coding for wires shall be per applicable NEC codes. All wiring shall be continuous between devices with no wire splices allowed in circuit runs.

2800.8.6.26 Nameplates. Provide adhesive backed printed nameplates for all internal devices such as contactors, circuit breakers, and relays. Provide engraved phenolic nameplates, black letters on white background, for door-mounted devices such as selector switches, push-buttons, circuit breaker toggles, and pilot lights. Nameplates shall be secured firmly to the panel.

2800.8.6.27 Control Panel Electrical Rack. An electrical equipment rack, as shown on drawings, shall be supplied by the manufacturer of the control panel for installation by the electrical contractor. The equipment rack shall be constructed of double-back Unistrut™, Type 304 stainless steel material with required conduit connecting meterbase, fused disconnect switch, control panel, seal fittings, and fiberglass reinforced plastic (FRP) junction box. If a lightning arrestor for the control panel is specified elsewhere, it may be mounted on the exterior of the disconnect switch, in lieu of the control panel, if desired.

All wiring between components on the electrical rack shall be run in galvanized heavy wall conduit, minimum ½ inch diameter. All wire shall be not less than 12 AWG stranded type THHN/THWN, except control wiring, which may be 14 or 16 AWG stranded type THHN/THWN. All wiring shall be color coded by wire insulation.

2800.9 EXECUTION. All equipment and accessories delivered to the job site shall be inspected for damage by both the Contractor and the City or their representative. Equipment shall be stored per the manufacturer's recommendations. All equipment or materials found to have defects, whether before or after installation, will be rejected and shall be repaired or replaced by the Contractor, at no additional cost to the City.

Installation shall be in accordance with the manufacturer's instructions and recommendations and as shown on plans. The pump assemblies shall be installed under the supervision of manufacturer's authorized representative. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Failure to comply with these specifications will result in the rejection of the work by the City.

2800.9.1 Installation of Structures. All structures such as the wetwell, valve vault, fences, concrete bases and the control panel base shall be constructed as detailed on the plans and as called for in these specifications. All access frames and covers shall be properly set and installed as recommended by the manufacturer.

2800.9.2 Pump and Motor Installation. The pump and motor units shall be carefully installed as recommended by the manufacturer and the seals between pumps and pump bases must mate as intended. The pump and motor units shall be properly wired and field checked to see that they can be easily removed and replaced by means of the lifting chains and do not bind on the guide rails.

2800.9.3 Electrical and Controls. The electrical and control system shall be as specified hereinbefore and shall all be installed in accordance with the NEC. The complete system shall be provided and installed by a single supplier. The Contractor shall contact the local power supplier and install all lines to the control panel, including metering in accordance with their requirements. The electric meter shall be installed as close to the station as allowed by the power utility. Seal all conduit penetrations with Perma Gum or Duct Seal. Provide separate conduit for each pump and float switch. Provide stainless steel hooks for float switches.

2800.9.4 Installation of Piping. Piping shall be installed as shown on the plans and basically in accordance with the Standard Specifications of the City of Shreveport.

2800.9.5 Startup & Testing. Prior to testing, all equipment shall be calibrated and verified by the pump station manufacturer's authorized representative. Contractor shall provide City completed Equipment Supplier's Certificate of Installation prior to startup and testing, blank form provided at the end of this specification. All tests shall be conducted in the presence of the City's representative. Contractor shall provide the City with one week written notice prior to testing.

Leakage tests performed on manholes, shall be performed on the wetwell, see specification 2300. Pump testing shall consist of pumping water out of the wetwell to ensure that the pumps operate as proposed. Pumping conditions shall be verified against the withdrawal rate of the wetwell, and the pressure gauge reading. During pumping tests, the valves and the flow meter shall also be tested for proper operation, leaks and performance. All controls and alarms shall also be tested. All alarm conditions shall be simulated and the City's SCADA system shall be programmed and shown to operate as intended. City's staff shall be present whenever testing water is needed to verify that proper backflow protection is installed and used. If defective work product or equipment is found during the course of testing, the Contractor shall repair/rectify such defects to the satisfaction of the City, and repeat tests at no cost to the City. Following these tests, the pump station shall successfully operate for a period of 24 hours.

After issuing Final Completion, the City will operate the submersible lift station for a minimum of 30 calendar days to verify proper operation and performance of the facility. Any work items found during this time to not meet the specifications will be rectified by the Contractor at no cost to the City.

2800.9.6 Site Cleanup, Restoration and Grading. After work is completed, the site of the lift station installation shall be cleared of all construction material and other debris. Grading shall consist of providing proper drainage and all sites shall be left in a neat, clean and acceptable condition. For all property the site shall be restored to a condition equal to, or better than, it's condition before the work was started. In any existing or proposed lawn areas, the final restoration shall include sodding.

2800.9.7 Measurement and Payment. Completed and accepted packaged sewer lift station shall be paid as one lump sum (LS). The price shall be full compensation for furnishing, testing and installing the wetwell, vaults, pumps, valves, coating, flow meter, controls, communication equipment, access road, fence, cleanup, restoration, finishing and grading. Payment shall be made after receipt of all associated record drawings.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2800 (I)	Packaged Sewer Lift Station	(LS)

EQUIPMENT SUPPLIER'S CERTIFICATE OF INSTALLATION

City _____

Project _____

Contract No. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial no.)

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on :

Date _____

Time _____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date: _____

SECTION 2810

WET WELL LINING SYSTEM

2810.1 GENERAL. This specification may include wet well liner systems that may not apply to all projects. Contractor shall install a wet well liner system as indicated in the Contract Documents.

2810.2 SCOPE OF WORK. The contractor shall coat concrete wetwells as shown and specified within the Contract Documents using either an Epoxy Lining System or a Multi-Component Stress Panel Lining System, as directed by the Engineer.

This section covers all workmanship, materials and quality requirements for rehabilitation and lining work on the interior surfaces of wetwells. Contractor shall provide and apply resurfacing and lining materials as specified and as indicated on drawings and per manufacturer's instructions and design details.

Lining shall be applied to all interior surfaces of the wet well, wet well access manhole and basket screen structure including ceiling/roof (not including hatches) and walls. The lining system shall be terminated per manufacturer's recommendations at the floor of the structures.

2810.3 REFERENCES. This section contains references to the documents listed below. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Referenced publications found within this specification shall be the latest revision unless otherwise specified; and applicable parts of the referenced publications shall become a part of this specification as if fully included.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 308.1	Guide to Curing Concrete

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASC Z9.4	Exhaust Systems Abrasive Blasting Operations Ventilation and Safe Practices for Fixed Location Enclosures

ASTM INTERNATIONAL (ASTM)

ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

ASTM C348	Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars

ASTM C403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C496	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C868	Standard Test Method for Chemical Resistance of Protective Linings
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D412	Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers Tension
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4259	Standard Practice for Abrading Concrete
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E337	Standard Test Method for Measuring Humidity with a Psychrometer(the Measurement of Wet- and Dry-Bulb Temperatures)
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F710	Standard Practice for Preparing Concrete Floors and Other Monolithic Surfaces to Receive Resilient Flooring

U.S GENERAL SERVICES ADMINISTRATION

F 595B

Federal Standard Colors

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI Guideline No. 03732

Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers, and Polymer Overlays

NACE INTERNATIONAL (NACE)

NACE Pub. 6D-173

A Manual for Painter Safety

NACE Pub. 6F-163

Surface Preparation of Steel or Concrete Tank Interiors

NACE Pub. 6G-164

Surface Preparation Abrasives for Industrial Maintenance Painting

NACE Pub. TPC2

Coatings and Linings for Immersion Service

NACE RP0288

Inspection of Linings on Steel and Concrete

NACE RP0892

Coatings and Linings over Concrete for Chemical Immersion and Containment Service

NACE SP0188

Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-SP12

Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultra High- Pressure Water Jetting Prior to Recoating

SSPC-SP13

Surface Preparation of Concrete

SSPC-Guide 12

Guide for Illumination of Industrial Painting Project

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

OSHA 1915.35

Painting

OSHA- 29 CFR 1926.651

Specific Excavation Requirements

2810.4 QUALITY ASSURANCE.

1. Do not use or retain contaminated, outdated, or diluted materials. Do not use materials from previously opened containers.
2. Use only products by approved manufacturers. All materials must be compatible. Provide same material product for touch-up as for original material.
3. If any requirements of this specification conflict with a referenced standard, the more stringent requirement shall apply.
4. Make available all locations and phases of the work for access by the City and the Engineer or other personnel designated by the Engineer. The Contractor shall provide ventilation and egress to safely access the coating work areas for inspection.
5. Conduct work so that the system is installed as specified herein. Inspect work continually to ensure that the system is installed as specified herein. The Contractor shall inspect the work to determine conformance with the specifications and referenced documents. The Contractor shall inform the Engineer of the progress and the quality of the work through daily reports as specified below. Any nonconforming lining system work shall be corrected as specified herein or as recommended by the manufacturer.
6. Summarize test data, work progress, areas covered, ambient conditions, quality control inspection test findings, and other information pertinent to the system installation in daily reports to be submitted to the Engineer.
7. Applicators shall have at least five years of experience performing lining work of similar size and complexity as the work specified in this Section and with the materials that are being used. Applicators shall be certified or approved by the lining system manufacturer. Submittals to verify these qualifications are to be made within thirty (30) days of the Notice-to-Proceed and are subject to approval by the Engineer.

2810.5 CONTRACTOR SUBMITTALS.

Furnish submittals in accordance with City of Shreveport Standard Specifications.

Submit the following prior to commencing with any phase of the work covered by this Section:

1. Manufacturer's current printed recommendations and product data sheets for all lining system products supplied under this section including performance criteria, surface preparation and applications, volatile organic compound (VOC) data, and safety requirements.
2. Material Safety Data Sheets (MSDS) for any materials brought on-site including all resurfacing system materials, solvents, and abrasive blast media.
3. Storage requirements including temperature, humidity, and ventilation for resurfacing system materials.
4. Manufacturer's requirements, including application procedures for resurfacing materials shall be in writing and shall be followed in detail. All safety precautions recommended by the manufacturer shall be strictly adhered to at all times when work is in progress.
5. Submit applicators' certification that resurfacing materials comply with Federal, State, and Local regulations for VOC.

6. Submit daily reports that contain the following information: Substrate conditions, ambient conditions, application procedures, work completed and location thereof. Mark-up drawings that show location of work.
7. Submit letter(s) with associated product data signed by manufacturer certifying that submitted products are suitable for application on the surfaces to be resurfaced and for the service conditions.

2810.6 DELIVERY AND STORAGE. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.

Store all materials only in area or areas designated by the Engineer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of materials-related debris before authorized disposal, to these areas. All materials are to be stored on pallets or similar storage/handling skids off the ground in sheltered areas in which the temperature is maintained between 50°F and 90°F or as per manufacturer's recommendations.

Mix all materials in an enclosed mixing area. This enclosed area must protect the mixing operation and materials from direct sunlight, inclement weather, freezing, or other means of damage or contamination. Protect all other concrete and metallic surfaces and finishes from any spillage of material(s) within the mixing area. Do not use floor drains, dikes or storm drains for disposal of any materials.

The Contractor shall take all precautions and implement all measures necessary to avert potential hazards associated with the resurfacing system materials as described on the pertinent MSDS or container labels. Deliver all materials to the job site in their original, unopened containers. Each container shall bear the manufacturer's name and label.

Labels on all material containers must show the following information:

1. Name or title of product.
2. Federal Specification Number if applicable.
3. Manufacturer's batch number and date of manufacture.
4. Manufacturer's name.
5. Generic type of material.
6. Application and mixing instructions.
7. Hazardous material identification label.
8. Shelf life date.
9. Storage requirements.

All containers shall be clearly marked indicating any personnel safety hazards associated with the use of or exposure to the materials. All materials shall be handled and stored to prevent damage or loss of label. Material storage and mixing areas shall be designated by the Engineer. Do not use or retain contaminated, outdated, prematurely opened, diluted materials, or materials which have exceeded their shelf life.

2810.7 COORDINATION OF WORK. The contractor shall coordinate with the Engineer regarding availability of work areas, completion times, safety, access and other factors which can impact plant

operations.

2810.7.1 Safety. The Contractor's work forces should comply with the provisions outlined in the following documents:

1. SSPC-PA-3 - "A Guide to Safety in Paint Application"
2. NACE Pub. 6D-173 - "A Manual for Painter Safety"

The Contractor shall provide personnel with all safety equipment necessary to protect them during any phase of the work. This shall include, but not be limited to safety glasses, goggles, earplugs, hard hats, steel toed work shoes, appropriate personal protective clothing, gloves, and plant approved escape respirators (where required).

No work shall be performed until the appropriate Work Requests and lock-outs have been submitted to the Engineer. The Work Request system provides a mechanism to advise plant staff of a contractor's work activities. The Lockout system is a safety procedure to prevent unintended equipment activation.

Keep any flammable materials such as cleaning solvents, thinners, or resurfacing materials away from open flames, sparks or temperatures higher than 150°F. Drums containing flammable materials shall be grounded. No solvent in any quantity shall be allowed inside containment enclosures or permitted confined spaces at any time during resurfacing work.

Power tools are to be in good working order to avoid open sparking. No spark producing tools shall be utilized in restricted areas as indicated herein.

The Contractor shall fireproof all work areas by maintaining a clean work area and having Underwriter's Laboratories approved fire extinguishers on-hand. The Contractor shall furnish these fire extinguishers.

Complete the disposal process at the end of each day. Final disposal of these materials is the Contractor's responsibility.

Matches, smoking, flames, or sparks resulting from any source including welding, must be remote from the work area during coating work.

2810.8 SITE CONDITIONS.

1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
2. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
3. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
4. Wind: Do not spray coatings if wind velocity causes overspray of the coating materials. Contractor shall be responsible for rectifying all overspray claims.

2810.9 MANUFACTURERS. Materials specified are those that have been evaluated for the specific service. Products shall be as manufactured by Tnemec Company, Inc., Dinjer, Warren Environmental, and CCI Spectrum, Inc or approved equal. As part of the proof of equality, the Engineer will require at the cost of the Contractor, certified test reports from a nationally known, reputable and independent testing laboratory conducting comparative tests as directed by the Engineer between the product specified and the requested substitution.

Requests for substitution shall include manufacturer's literature for each product giving name, product number, and generic type, descriptive information, solids by volume, recommended dry film thickness and certified lab test reports showing results to equal the performance criteria of the products specified herein.

In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service.

2810.10 MATERIALS.

2810.10.1 Epoxy Lining System.

The following list specifies the material requirements for lining systems. The system shall include shotcrete and epoxy lining. Shotcrete shall be applied to bring surfaces out to half (1/2") an inch beyond the original grade. The approved products are as follows:

1. Shotcrete: Master Builders EMACO S88 CI; Sikacem 103; Dinjer CMS-10K or approved equal:
 - a. Shall be a Portland Type I or Type II cement based material with no polymer additives and with the following minimum performance properties:
 - b. Compressive Strength: ASTM C109 - Minimum 7000 psi at 7 days
 - c. Freeze Thaw: ASTM C666 - After 300 cycles, Minimum 95%
 - d. Splitting Tensile Strength: ASTM C496 - Minimum 500 psi at 7 days
 - e. Flexural Strength: ASTM C 348 - Minimum 1000 psi after 7 days
 - f. Direct Bond Strength: Minimum 290 psi after 28 days
 - g. Calcium-Aluminate based materials will not be approved for use on this project.
2. Warren Environmental Structural Mastic (WEMFR-301) at a thickness of 380 mils will be allowed as an acceptable alternative to the above listed Shotcrete systems.
3. Epoxy Lining: Tnemec Perma-Shield Series 434, Dinjer SG Mastic, Warren Environmental S-301, or approved equal. Minimum thickness of 125 mils.

2810.10.1.1 Minimum Performance Requirements.

- a. Lining materials must be tested in a controlled autoclave containing 536 ppm H₂S, 10% H₂SO₄, 4,000 ppm NaCl @ 150°F for 28 days.
- b. Autoclave testing must be performed by an independent laboratory.
- c. The lining materials must exhibit the following when tested using Electrical Impedance Spectroscopy (EIS):
 - i. Initial EIS impedance of 10 Log Z (Z in ohms cm² @ 0.1 Hz)
 - ii. Final EIS impedance greater than 9 Log Z after 28 days exposure
 - iii. No blistering cracking, checking, or loss of adhesion after 28 days exposure to the H₂S autoclave.

2810.10.1.2 Multi-Component Stress Panel Liner System.

1. The following list specifies the material requirements for multi-component stress panel liner systems. The approved products are as follows:

Moisture Barrier and Final Corrosion Barrier: Spectrashield, or approved equal.

2. Shall be a sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment – with the following typical chemical analysis:

“A” Component

Viscosity, 77° F, cps.,	300-400
Physical State	Liquid
Color	Clear to amber
Hygroscopicity	Reacts with water

B” Component

Viscosity, 160° F, cps.,	400-600
Physical State	Liquid
Color	Flamingo Pink
Non-Volatile	100%

REACTION PROFILE (100 grams, 175° F sample)

Gel Time, seconds	1-2
Tack Free Time, seconds	15
Cure Time, seconds	30
A System / B System, volume ratio	1.00 / 1.00

TYPICAL PHYSICAL PROPERTIES

Tensile Strength (PSI)	ASTM D412	2670
Elongation (%)	ASTM D412	430
100% Modulus	ASTM D412	2200
300 % Modulus	ASTM D412	2600
Tear Strength (PLI)	ASTM D2240	280
Hardness (shore D)	ASTM D1737	42
Flashpoint (°F)	ASTM Pensky-Martens	>200
Taber Abrasion (mg loss)	ASTM D4060	25

3. Surfacers: Spectrashield, or approved equal, Polyurethane Rigid Structure Foam

Typical Chemical Analysis:

“A” Component

Viscosity, 77° F, cps.,	200
Physical State	Liquid
Color	Dark Brown
Hygroscopicity	Reacts with water and evolves CO2 gas

“B” Component

Viscosity, 77° F, cps.,	600-1000
Physical State	Liquid
Color	Tan
Hygroscopicity	Absorbs water rapidly thus changing ratio

REACTION PROFILE (100 GRAMS, 77° F SAMPLE)

Cream Time, seconds	1-4

Tack Free time, seconds	5-8
Rise Time, seconds	6-10
Processing	
A System / B System, volume ratio	1.00 / 1.00

4. If dry or wet abrasive blast cleaning is the selected method of surface preparation, provide slag grit of a sieve size, gradation, and quality necessary to produce the degree of cleanliness and surface profile required herein.

2810.11 EXECUTION.

2810.11.1 General.

The Contractor shall be responsible for the cleanup of the wetwell, including disposal of wastes, sludge, debris, deposits, etc.

Hoisting, Scaffolding, Staging, and Planking:

1. Provide, set-up, and maintain all required hoists, scaffolds, and staging and planking, and perform all access related hoisting work required to complete the work of this section as indicated and specified.
2. Scaffolds shall have solid backs and floors to prevent dropping materials from there to the floors or ground below.

Environmental Requirements:

1. Comply with the manufacturer's recommendations as to environmental conditions under which materials can be applied.
2. Do not apply materials when dust is in work site.
3. The Contractor shall provide all temporary lighting during the work.

Protection:

1. Cover or otherwise protect finish work or other surfaces not being lined.
2. Erect and maintain protective tarps, enclosures and/or maskings to contain debris (such as dust or airborne particles resulting from surface preparation) generated during any and all work activities. This includes, but is not limited to, the use of dust/debris collection apparatus as required.

Initial Inspection of Surfaces to be lined:

1. It is the responsibility of the Contractor to inspect and report unacceptable concrete substrate surface conditions to the Engineer prior to the commencement of surface preparation activities.
2. Unacceptable concrete surface conditions are defined as the presence of water infiltration/inflow, cracked surfaces or concrete deteriorated to a depth of greater than one (1") inch or otherwise unable to withstand surface preparation as specified herein.
3. Verify that the pH of the cleaned concrete surfaces to be coated is within a range acceptable to the lining manufacturer. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

4. Unacceptable steel or ductile/cast iron surface conditions are defined as severely corroded and/or perforated metals and are unable to withstand surface preparation as specified herein.

Thinners and Solvents:

1. The Contractor shall use only solvents and thinners as recommended by the Manufacturer.

2810.11.2 Surface Preparation Requirements For Epoxy Lining System.

All specified surface preparation shall be performed in accordance with the latest version of the SSPC, NACE, ICRI and other standards referenced in this section.

Corroded concrete surfaces shall be repaired to their original condition. Allow new concrete to cure a minimum of 28 days. Contractor may verify dryness by testing for moisture with a "plastic film tape down test." (Reference ASTM D 4263). For horizontal surfaces, perform a Calcium Chloride test in accordance with ASTM F1869. If test results indicate moisture levels outside the acceptable range prescribed by the manufacturer, contact the manufacturer. Do not proceed with the coating application.

Prior to applying shotcrete, all existing areas that are scheduled to receive the chemical resistant lining shall be steam cleaned with minimum 210°F water with alkaline –based detergent to remove all loose materials, acid constituents, grease, oil, and other contaminants. Oil and grease shall be removed before mechanical cleaning is started.

Mechanically abrade all surfaces to be coated to remove laitance, curing compounds sealer and other contaminants and to produce a minimum surface profile equal to ICRI CSP 5 (Reference SSPC-SP13). This preparation will be followed by vacuum cleaning to remove all dust, dirt or friable substances leaving clean, dust free surfaces for resurfacing.

Prior to applying shotcrete, identify and stop all active cracks from leaking using either a hydraulic cement or a chemical grout such as DeNeef Flex LV or equal. The set time of the Hydraulic Cement shall be approximately 1 minute to 90 seconds per ASTM C403. The compressive strength of the hydraulic cement shall be approximately 1000 psi after 1 hours per ASTM C109. All products are to be applied in accordance with manufacturer's instructions.

For all areas (except new concrete surfaces), apply shotcrete to bring surfaces out to half (½") an inch beyond original grade. The application shall result in a finish that covers all exposed aggregate and results in no surface voids, discontinuities or irregularities. Cure in accordance with manufacturer's instructions and in accordance with ACI 308.1.

All shotcreted surfaces shall be abrasive blasted to remove all laitance from release agents, curing compounds sealers and other contaminants and to produce a minimum surface profile of ICRI CSP 5. This preparation will be followed by vacuum cleaning to remove all dust, dirt or friable substances leaving clean, dust free surfaces for resurfacing. The air used for blast cleaning shall be free of oil and moisture to not cause contamination of the surfaces to be resurfaced.

Cleaning and resurfacing shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly resurfaced areas. Prepare concrete joint and install sealant following resurfacing material installation per the manufacturer's written instructions and requirements.

Initial Cleaning / Decontamination:

All existing areas to be lined shall be pressure washed with alkaline –based detergent to remove all loose materials, acid constituents, grease, oil, and other contaminants. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 9 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

Abrasive Blast Cleaning:

1. Used or spent blast abrasive shall not be reused on work covered by this section.
2. The compressed air used for blast cleaning will be filtered free of condensed water or oil. Moisture traps will be cleaned at least once every four hours or more frequently as is appropriate.
3. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. Oil separators shall be cleaned at least once every four hours or more frequently as is appropriate.
4. A paper blotter test shall be performed by the Contractor when requested by the Engineer or the Engineer's representative to determine if the air is sufficiently free of oil and moisture.
5. Regulators, gauges, filters, and separators will be in good working order for all of the compressor air lines to blasting nozzles at all times during this work.
6. An air dryer or drying unit shall be installed which dries the compressed air prior to blast connections. This dryer shall be used and maintained for the duration of surface preparation work.
7. The quality, volume, and velocity of life support and ventilation air used during surface preparation shall be in accordance with applicable safety standards and as required to ensure adequate visibility and proper dissipation of volatiles without impacting the prepared surface or the health of the public or personnel working for the Contractor, Subcontractors, Engineer, Engineer's Representatives, or anyone who may be affected by on-site maintenance coating work activities.
8. The abrasive blast nozzles used shall be the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and the necessary volume to obtain the required blast cleaning production rates and specified degree of cleanliness.
9. The Contractor must provide adequate ventilation for airborne particulate evacuation and lighting (meeting all pertinent safety standards) to optimize visibility for both blast cleaning and observation of the substrate during surface preparation work.
10. All phases of surface preparation work specified herein must be inspected by the Engineer before the Contractor proceeds with the subsequent phase of surface preparation.
11. If between final surface preparation work and coating application, contamination of the prepared and cleaned substrate occurs, or if the prepared steel's appearance darkens or changes color, reblasting will be required until the specified degree of cleanliness is established.

2810.11.3 Specific Surface Preparation Requirements For Epoxy Lining System.

In addition to the Section 2810.11.2 requirements, the Contractor will follow the requirements of this section.

Where the coating is specified to be terminated, the Contractor shall prepare and apply materials per manufacturer's recommendations. For applications around penetrations and/or drains, the contractor shall prepare and apply coatings per manufacturer's recommendations. The Contractor shall notify the Engineer, should jobsite conditions prevent the above operations and/or applications.

Where the coating is specified over control or construction joints, the Contractor shall prepare and apply coatings per manufacturers recommendations. Where the coating is specified over expansion joints, the Contractor shall prepare and apply coatings as per manufacturers recommendations. When encountered, the Contractor shall prepare the surfaces exposing rebar per manufacturer's recommendations.

The Contractor shall notify the Engineer should jobsite conditions prevent the above operations and/or applications.

2810.11.4 Application Requirements For All Lining Systems.

General.

1. Areas not to be lined shall be masked using duct tape or other protection materials to prevent these surfaces from being resurfaced.
2. Ensure straight even termination of resurfacing/topcoat materials on wall edges and flush with embedded steel.
3. The Contractor must follow the minimum and maximum recoat limitation times and related temperature range restrictions between successive lifts for all products specified herein per Manufacturer's stated requirements.
4. All equipment and procedures used for lining system application shall be as recommended by the manufacturer.
5. Unless specified elsewhere herein, the Contractor shall comply with the manufacturer's most recent written instructions with respect to the following:
 - a. Mixing of All Materials.
 - b. Protection and Handling of All Materials.
 - c. Recoat Limitation and Cure Times.
 - d. Minimum Ambient and Substrate Temperatures, Substrate's Degree of Dryness, Relative Humidity, and Dew Point of Air.
 - e. Application.
 - f. Final Curing.
 - g. Use of Proper Application Equipment.
 - h. Curing of Resurfacing System.

The applied resurfacing system shall be protected from damage during curing and shall be cured as recommended by the manufacturer. Ambient conditions shall be controlled by the Contractor during the curing period to ensure that minimum air temperature and minimum relative humidity as required by the manufacturer is maintained.

2810.11.5 Installation Of Epoxy Lining System.

General Note: The Contractor is advised that with all thick-film, quick curing materials applied to concrete surfaces, outgassing of the concrete can occur. Possible remedies include applying materials when the temperature of the concrete surfaces are descending, or applying a thin one-eighth (1/8") inch layer of the specified surfacing material. Other remedies may exist, and may be submitted for the Engineer's approval.

Apply shotcrete/structural mastic (Master Builders EMACO S88 CI; Sikacem 103; Dinjer CMS-10K; Warren Environmental Structural Mastic (WEMFR-301) or approved equal). After shotcreting/applying structural mastic, prepare surfaces as described in 2810.12.2.

Apply lining coat (Tnemec Series 434 Permashield; Dinjer SG Mastic; Warren Environmental S-301; or approved equal chemical resistant mortar) to all surfaces scheduled to be coated at a nominal thickness of 125 mils. Application shall be either by trowel or spray. If spray-applied, material shall be finish-troweled to a hard, dense film.

2810.11.6 Surface Preparation Requirements For Multi-Component Stress Panel Liner System.

All specified surface preparation shall be performed in accordance with the latest version of the SSPC, NACE, ICRI and other standards referenced in this section.

Corroded concrete surfaces shall be repaired to their original condition. Allow new concrete to cure a minimum of 28 days. Contractor may verify dryness by testing for moisture with a "plastic film tape down test." (Reference ASTM D 4263). If necessary for testing horizontal surfaces, Calcium Chloride test in accordance with ASTM F1869. If test results indicate moisture levels outside the acceptable range of the manufacturer, contact the manufacturer. Do not proceed with the coating application.

Prior to applying first layer, all existing areas that are scheduled to receive the chemical resistant lining shall be hydro-blasted using a minimum of 20,000 psi. Mechanically abrade all surfaces to be coated to remove laitance, curing compounds sealer and other contaminants and to produce a minimum surface profile equal to ICRI CSP 5 (medium-heavy shotblast). Reference SSPC-SP13.

Cleaning and resurfacing shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly resurfaced areas.

Cleaning / Surface Preparation:

All existing areas to be resurfaced shall be hydro-blasted with at least 20,000 psi to remove all loose materials, acid constituents, grease, oil, and other contaminants. Structures six feet (6') in diameter or greater, and those with large flat walls shall use a 40,000 psi hydro-blaster to achieve the desired anchoring profile.

2810.11.7 Installation Of Multi-Component Stress Panel Liner System.

Apply Moisture Barrier (Spectrashield, or approved equal). This layer of polyurea shall be spray applied at a nominal thickness of 70 mils to all surfaces one foot below the low flow line. Mechanical anchoring system shall be embedded and sprayed into the liner at all infiltration locations and at all wall/floor termination.

Apply Surfacers (Spectrashield, or approved equal). This layer of polyurethane rigid structure foam shall be spray applied to all surfaces previously lined with the moisture barrier. This layer shall be applied at a nominal thickness of 440 mils. This layer may be thicker depending on the condition of the substrate.

Apply Final Corrosion Barrier (Spectrashield, or approved equal) to all surfaces lined with the Surfacing layer shall be spray applied at a nominal thickness of 80 mils in accordance with manufacturer's instructions.

2810.11.8 Safety and Ventilation Requirements.

Requirements for safety and ventilation shall be in accordance with SSPC Paint Application Guide No. 3.

2810.11.9 Field Quality Control Inspection.

Inspection by the Engineer or others does not limit the Contractor's responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.

Perform the quality control procedures listed below in conjunction with the requirements of this Section.

Inspect all materials upon receipt to ensure that all are supplied by the manufacturer.

Provide specified storage conditions for the resurfacing system materials, solvents, and abrasives.

If using the Epoxy Lining System, inspect and record findings for the degree of cleanliness of substrates using. The pH of the concrete substrate shall be measured using pH indicating papers. pH testing is to be performed once every 50 sq. ft. Acceptable pH values shall be between 9.0 and 11.0 as measured by a full-range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH.

Inspect and record substrate profile (anchor pattern). Surfaces shall be abraded, as a minimum, equal to the roughness of 40 grit sand paper.

Measure and record ambient air temperature once every two hours of each shift using a thermometer and measure and record substrate temperature once every two hours using a surface thermometer.

Measure and record relative humidity every two hours of each shift using a sling psychrometer in accordance with ASTM E337.

Provide correct mixing of resurfacing materials in accordance with the manufacturer's instructions.

Inspect and record that the "pot life" of resurfacing materials are not exceeded during installation.

Verify curing of the resurfacing materials in accordance with the manufacturer's instructions.

Upon full cure of Epoxy Lining System, the installed lining system shall be checked by high voltage spark detection in accordance with NACE RP0188-90 to verify a pinhole-free surface. Voltage shall be set at 11,000 volts. Areas which do not pass the spark detection test shall be corrected at no cost to the City and rechecked. High voltage spark detection shall be conducted on the chemical resistant mortar before the installation of the gel coat.

Upon completion of the lining system installation the lined area shall be cleaned and prepared to permit close visual inspection by the Engineer or the Engineer's Representative. Any and all deficiencies or defective work (not in compliance with this section or related sections) will be marked for repair or removal/replacement by the Contractor at no additional cost to the City.

2810.12 ACCEPTANCE CRITERIA.

Acceptance Criteria for Surface Preparation Work:

All surfaces shall be prepared in accordance with the specification and referenced standards therein.

Acceptance Criteria for Coating System Application Work:

Acceptable coating work will be based upon the following:

1. No pock-marks, trowel marks, depressions, unconsolidated areas, pinholes or holidays in either size or frequency.
2. No intercoat bond failures between lifts.

3. Proper curing of coatings.
4. Resurfaced areas shall pitch to drains.

There shall be no areas that puddle when flood tested.

5. The Engineer or Engineer's Representative shall, at their discretion, inspect the following:
 - a. Profile and degree of cleanliness of substrate.
 - b. Thickness of materials/coverage rate confirmation.
 - c. Ambient temperature and humidity requirements and substrate temperature.
 - d. Curing and recoat times.
 - e. Proper curing of the lining materials.
6. Rework required on any holidays or any other inadequacies found by the Engineer or the Engineer's representative in the quality of the coating work shall be marked. Such areas shall be recleaned and reworked by the Contractor according to these specifications and the manufacturer's recommendations at no additional cost to the City.
7. The Contractor is responsible for keeping the Engineer informed of all progress so that inspection for quality can be achieved.
8. The Contractor is ultimately responsible for the quality performance of the applied materials and workmanship. Inspections by the Engineer or the Engineer's Representative do not limit this responsibility.

2810.13 FINAL INSPECTION.

Perform a final inspection to determine whether the resurfacing system work meets the requirements of the specifications. The Engineer and the Engineer's Representative will conduct final inspection with the Contractor.

2810.14 CLEANUP.

Upon completion of work, the Contractor shall remove surplus materials, equipment, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any work-related damage. The surrounding surface areas including roadways and all other surfaces shall be restored to their pre-project condition.

2810.15 WARRANTY.

The Contractor shall provide a minimum written five year warranty against failures. Failure includes any blistering, cracking or loss of adhesion of the coating to the existing concrete substrate. The coating system should not be damaged by any debris that enters the wet well. The warranty period shall start on the date of Final Completion.

2810.16 MEASUREMENT AND PAYMENT. Measurement of work for payment of this item shall be on a Lump Sum (LS) basis per wetwell lined. All rehabilitation work, performed in preparation to installing a protective liner shall be considered incidental to the installation of the liner system.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2810(1)	Wet Well Lining System	Lump Sum (LS)

SECTION 2900

SEWER LINE CLEANING

2900.1 DESCRIPTION. The work covered by this section consists of providing all labor, equipment, material and supplies and performing all operations required to clean sewer lines and manholes.

2900.1.1 Sewer Line Cleaning. The intent of sewer line cleaning is to remove foreign materials such as dirt, grease, rocks, sand and other materials and obstruction from the sewer lines and manholes. It is recognized that there are some conditions such as a broken pipe and major blockages that prevent cleaning from being accomplished where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the Contractor shall not be required to clean those specific sewer sections. If, in the course of normal cleaning operations, damage does result from pre-existing and unforeseen conditions such as broken pipe, the Contractor shall not be held responsible for such damages and the Engineer shall be notified immediately. The term "Contractor" as used in this section shall include the Contractor's subcontractors and other entities hired by the Contractor.

2900.2 MATERIALS.

2900.2.1 Disposal of Materials. The Engineer shall determine whether materials resulting from excavation, including but not limited to excavated materials, demolished pavement, arboreal (landscaping) waste and other debris are considered non-suitable or surplus waste material. All such waste materials shall become property of the Contractor and shall not be discharged into drainage channels, existing storm sewers, or existing sanitary sewers. Contractor shall be responsible for finding a suitable disposal site and obtaining all applicable permits. The Contractor shall also be responsible for dewatering and transporting material to disposal site.

The Contractor shall submit a Disposal Plan for preview and acceptance by the Engineer prior to performing any work that might generate waste materials. The plan shall include a complete description of the materials that are expected to be encountered and their proposed disposal site(s). The Contractor may change his Disposal Plan only by written notice to the Engineer. The acceptance of the plan and/or any related notice to the Engineer must be evidenced by a written response from the Engineer.

The Contractor shall obtain all permits related to his disposal operations, and the Contractor shall comply with all requirements of those permits. The Contractor shall show evidence that all required permits have been obtained for all disposal sites within the City or on any property owned by the City by submitting a copy of all such permits to the Engineer as part of the Contractor's Disposal Plan.

2900.3 CONSTRUCTION. The designated sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet or mechanically powered equipment. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes. If cleaning of an entire sewer section cannot be successfully performed from one manhole, the equipment shall be set up on an adjacent connected manhole. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed that a major blockage exists and the cleaning effort shall be abandoned.

2900.3.1 Cleaning Precautions. During all cleaning and preparation operations, all necessary precautions shall be taken to protect the sewer from damage. Maximum allowable pressure to be used is 3000 psi. During these operations, precautions shall be also be taken so that no damage is caused to public or private property adjacent to or served by the sewer or its branches. Any damage caused to public or private property as a result of such cleaning and preparation operations shall be promptly restored to preexisting conditions by the Contractor at no cost and liability to the City.

Satisfactory precautions shall be taken in the use of the cleaning equipment. When hydraulically propelled

cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer.

2900.3.2 Root Removal. Roots shall be removed in the designated sewer sections and manholes where root intrusion is a problem and when authorized by the Engineer. Special attention should be used during the cleaning operation to assure almost complete removal of roots from the joints. Any roots which could prevent the proper seating and application of a cured-in-place liner shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and porcupine, and equipment such as high-velocity jet cleaners. The Contractor shall capture and remove all roots from the line.

2900.3.2.1 Mechanical Root Removal. A power rodding machine shall be either a sectional or continuous rod type capable of holding a minimum of 750 feet. It shall have the ability to spin the rod either clockwise or counterclockwise, be able to be pushed straight out or pulled back without rotating the machine. The rod shall be specifically heat-treated steel. To insure safe operation, the machine shall be fully enclosed and have an automatic safety clutch or relief valve. Buckets, water cutters, scrapers, scooters, porcupines, brushes and other mechanical equipment may also be utilized. It is the Contractor's responsibility to ensure that all equipment is operated by experienced personnel so that sewer lines are not damaged in the process of cleaning. Sewer lines damaged due to negligence shall be repaired to the City's satisfaction at no additional cost to the City.

2900.3.3 High-velocity Jet (Hydro-Cleaning) Equipment. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. It shall be specifically designed and constructed for such cleaning. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.

2900.3.4 Waste Material Removal and Disposal from Sewerline Cleaning. All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid waste material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. When hydraulic cleaning equipment is used, a suitable dam or weir shall be placed in the downstream manhole to trap such materials. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.

Under no circumstance shall sludge or other debris removed during these operations be dumped or spilled into streets, ditches, storm drains or other sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of by the Contractor in a legal and sanitary manner as approved by appropriate authorities. Copies of records for disposal site, date, amount and a brief description of material disposed shall be provided to the City. All waste materials shall be removed from the site at the end of each workday. Under no circumstances will the Contractor be allowed to accumulate waste material, debris, etc., on site. The Contractor is advised that he shall not dispose of this material by illegal dumping on private or public property, by sale to others, or any means other than those given above.

The Contractor shall keep his haul route and work area(s) neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which may occur during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accordance with applicable law and regulations. The Contractor shall first notify City of Shreveport at (318) 673-6000 immediately of any spills. Secondly, the Contractor must attempt to contain the spill and isolate it from entry to any storm drain systems or waterways. Thirdly, the Contractor must attempt to relieve the spill. Once the spill has been contained and relieved, the Contractor shall immediately clean up the spill area using dry cleanup methods. If the Contractor fails to clean up such spill, or waste immediately, the City shall have the right to clean up or arrange for its

cleanup and shall charge the Contractor for all clean-up costs, including administrative costs and overhead, incurred by the City in connection with such cleanup. The City shall also charge the Contractor for any costs incurred or penalties imposed on the City as a result of any spill, dump, or discard. Under no circumstance is this material to be discharged into waterways or any place other than where authorized to do so by the appropriate authority.

The general requirements for vehicles hauling such waste material are as follows:

- a. Transport vehicles must be of type(s) approved for this application by the political jurisdictions involved. General requirements are that the vehicles have watertight bodies, be properly equipped and fitted with seals and covers to prohibit material spillage or drainage, and be cleaned as often as is necessary to prevent deposit of material on roadways.
- b. Vehicles must be loaded within legal weight limits and operated safely.
- c. The routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

2900.3.5 Acceptance of Cleaning Operation. Acceptance of sewer line cleaning shall be made upon the successful completion of the Closed Circuit Television (CCTV) inspection by the Contractor, and shall be to the satisfaction of the Engineer. Digital pictures shall have a minimum resolution of 72 dots per inch (dpi) x 72 dpi, and minimum dimensions of 1920 x 1080 pixels. If CCTV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect (CCTV) the sewer lines at no cost to the City, until cleaning is shown to be satisfactory. In areas where CCTV inspection is not performed, the Engineer may require the Contractor to pull a double squeegee (with each squeegee having the same diameter as the sewer) through each manhole section as evidence of adequate cleaning.

On all sewer lines which have sags or dips to an extent that the CCTV camera lens becomes submerged for three (3) or more feet during the inspection, the Contractor shall pull double squeegee and/or sponges through the line in order to remove the water from the dips or sags. Water removal through squeegees and/or sponges shall be performed until the CCTV camera lens is no longer be submerged. This requirement may be waived by the Engineer if the water in which the camera lens is submerged, is clear enough to allow the identification of pipe defects, cracks, holes and location of service connections.

2900.4 MEASUREMENT AND BASIS OF PAYMENT. For installation of new sanitary sewers or rehabilitation of existing sewers, this item shall be considered incidental to the installation. For other sewer line cleaning projects, this item will not be measured but shall be included in the linear foot price for "Sanitary Sewer Cleaning", which will be full compensation for all labor, incidentals, materials, resident notification, testing, necessary permits, ingress and egress procedures, by-pass pumping, sediment and root removal, removal of protruding service connections, dewatering, traffic control, erosion and sediment control, excavation pits, reinstatement of active service connections, sealing at manholes and service connections, clearing and grubbing required for mains located off street, cleaning, debris collection and disposal, root removal, pre- and post-television inspections, sealing the liner in the manholes, the cost of a temporary meter and municipal water obtained from a bulk water station, and all other rehabilitation work, not included under other items, necessary to complete the rehabilitation as shown, specified and directed.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
2900(1)	Sanitary Sewer Cleaning	Linear Foot (LF)

SECTION 3000

WATER MAINS

3000.1 GENERAL. The work to be performed under this section shall consist of furnishing and installing water mains, fittings and other appurtenances necessary to complete the installation as shown in the plans and as specified herein.

3000.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The most recent version of these references shall apply.

ASTM INTERNATIONAL (ASTM)

ASTM A536	Standard Specification for Ductile Iron Castings
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds
ASTM D2657	Standard Specification for Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D3350	Standard Specification for Polyethylene Plastics pipe and Fittings Materials
ASTM D5260	Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150	Thickness Design of Ductile-Iron Pipe

AWWA C151	Ductile-Iron, Centrifugally Cast
AWWA C153	Ductile-Iron Compact Fittings
AWWA C200	Steel Water Pipe 6 Inch and Larger
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot Applied
AWWA C205	Cement Mortar Protective Line and Coating For Steel Water Pipe 4 In and Larger Shop Applied
AWWA C206	Field Welding Of Steel Water Pipe
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C210	Liquid Epoxy Coating Systems For The Interior Exterior Of Steel Water Pipelines
AWWA C213	Fusion Bonded Epoxy Coating For The Interior & Exterior Of Steel Water Pipelines
AWWA C214	Tape Coating Systems For The Exterior Of Steel Water Pipelines
AWWA C216	Heat Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C218	Coating the Exterior Of Aboveground Steel Water Pipelines & Fittings
AWWA C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
AWWA C222	Polyurethane Coatings For The Interior & Exterior Of Steel Water Pipe & Fittings
AWWA C227	Bolted, Split-Sleeve Restrained And Nonrestrained Couplings For Plain-End Pipe
AWWA C301	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C304	Design Prestressed Concrete Cylinder Pipe

AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings for Water Transmission and Distribution
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76mm), for Water Service
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 in. Through 48 in. (350 mm Through 1,200 mm) for Water Transmission and Distribution
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100mm) through 63 In.,(1,575 mm) for Water Distribution and Transmission
AWWA M9	Concrete Pressure Pipe
AWWA M11	Steel Pipe: A Guide for Design and Installation

3000.3 CONSTRUCTION REQUIREMENTS.

3000.3.1 Delivery and Inspection of Construction Materials. All pipe, fittings and accessories delivered to the job site shall be inspected for damage by both the Contractor and the City or their representative. This inspection does not exempt the Contractor from supplying the materials specified by the Contract. All materials found to have flaws, cracks or other defects (including ultraviolet degradation), whether before or after installation, will be rejected and will be repaired or replaced by the Contractor as directed by the City, at no additional cost.

The Contractor shall take precautions to protect the interiors of pipes, fittings, and valves that will be used in potable water distribution systems against contamination.

Such precautions may include, but is not limited to, bagging fittings and valves, installing end caps, plugs, plastic film cover, netting or other protective barriers on pipe ends that will keep rodents, insects, dirt, ditch water, foreign matter, and other potentially contaminating matter from inside the joints until they are installed in the trench. Special care shall be taken to avoid damage to coatings and linings of pipe and fittings; make repairs if coatings or linings are damaged.

3000.3.2 Installation Requirements. As a general rule, municipal water mains are defined as those lines between 8" and 14" in diameter and can be tapped, while transmission mains are 16" and larger and are not to be tapped without prior approval of the Engineer.

Water main bedding requirements will vary for the type of water main being installed, (Rigid or Flexible). Bedding materials shall be installed as per STANDARD PLAN No 3000-1 or 3000-2 as required. All pipe and fittings shall be installed to the line and grade as detailed on the plans. Subject to the approval of the Engineer, other fittings may be added to or substituted for those shown on the plans, should the need arise during construction. The Contractor is fully responsible for furnishing and installing all fittings required for a complete and proper installation of the mains.

Excavated trench shall be of sufficient width to allow proper handling of the pipe and thorough compaction of the backfill around the pipe. The subgrade shall be accurately shaped and trimmed to support the pipe barrel. Each pipe section, when in place, shall have a uniform bearing on the subgrade for

the full length of the pipe barrel.

Unless otherwise indicated on the plans or authorized by the Engineer, water mains shall be installed to clear all utility lines and shall have a minimum of five (5') feet of cover. Proper equipment shall be used for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water; and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and for dewatering of trenches during construction shall be borne by the Contractor (see Trench Dewatering Section 1005).

All dirt and other foreign matter shall be removed from the inside of pipe and fittings before they are lowered into the trench. Pipe and fittings shall be kept clean during and after laying. Care shall be taken to keep dirt out of the jointing space.

Unless written permission is given by the Engineer, the pipe shall not be strung more than what can be accomplished in one day. At the end of each day's work, and when pipe laying is discontinued for any appreciable period, open ends of pipe shall be closed with a cast plug or cap securely placed in all openings and at the end of the line. Pipe shall be supported to proper line and grade and secured against upheaval or floating during the placement of bedding.

All pipe and fittings shall be lowered carefully into the trench in such manner as to prevent damage to pipe, fittings, or linings. Neither pipe nor fittings shall be dropped or dumped into the trench. Pipe shall be carried to trench and not dragged. Cutting of pipe, where needed, shall be done in a neat and workman like manner without damage to pipe or pipe lining.

Unless otherwise directed by the Engineer, pipe shall be laid with bell ends facing the direction of laying. For lines on an appreciable slope, bells shall, at the direction of the Engineer, face up-grade. Wherever necessary to deflect pipe from a straight line in either the horizontal or vertical plane, to avoid obstructions, or for other acceptable reasons, the degree of deflection at any joint shall not be greater than fifty percent (50%) of the pipe manufacturer's recommendation.

3000.3.2.1 Trace Wire. Trace wire, that permits easy detection of underground pipe, shall be installed adjacent to all nonmetallic water pipe. Wire shall be attached to top of pipe in such a manner that it will not be displaced during construction operations. Trace wire shall be fourteen (14) gauge single strand plastic coated copper wires.

3000.3.2.2 Mechanical Restraints. All pipe fittings (bends, tie-ins, valves, etc) shall be restrained using mechanical thrust restraints. Restraint lengths shall be as specified in the Plans and Specifications. Restraint lengths and restraint type shall be as approved by the Engineer. Where indicated on the drawings, or otherwise required by the contract documents, all pipe joints (pipe to pipe connections) shall be restrained. Restrainted joints shall meet requirements of AWWA C110, C111, C151, and C153 standards. Joint design shall utilize a high strength ductile iron or structural steel gland assembled on the pipe along with retainer lugs, conforming to ASTM A536 strength requirements, latest revision. Stainless steel or corrosive resistant high strength alloy nuts, bolts and rods, conforming to ASTM A242 and AWWA C111, shall complete the restrained joint assembly, delivering a full circumferential contact and support of the pipe wall.

3000.3.2.3 Concrete Thrust Blocking. Concrete thrust blocking shall be used where called out in the contract documents. Class A concrete shall be placed, as shown on the construction plans or as otherwise directed by the Engineer, in such a manner that will substantially brace the pipe against undisturbed trench walls.

Concrete blocking, made from Type I cement, shall have been in place four (4) days prior to testing the pipeline as hereinafter specified. Test may be made two (2) days after completion of blocking if Type III cement is used. See STANDARD PLANS No. 3000-4; 3000-5 & 3000-6.

Concrete blocking, unless otherwise specified, will not be measured or paid for as a separate item, but the cost thereof shall be included in the various items listed in the Proposal.

3000.3.2.4 Final Cleaning & Testing. All completed water mains of diameters 8-inches and above shall be cleaned (by pigging) and shall be tested in accordance with Specification 3100.

3000.3.2.5 Backfilling. Refer to Section 1002 for backfilling specifications.

3000.3.2.6 Dead End Water Main. All City approved dead-end water main installations shall require a permanently installed fire hydrant. Refer to Specification Sections 209 and 3300.

3000.4 MEASUREMENT AND BASIS OF PAYMENT. The pipeline, complete in place, will be measured for payment in linear feet along the centerline of the pipe actually installed. Measurement shall be through all fittings, specials, valves, etc., and no deduction in length or increase in payment shall be made for such appurtenances. Installation of the pipeline will be paid for at the unit contract price per linear foot as provided in the Bid Schedule. All water pipeline fittings and 2'x2' concrete pads to stabilize the pipe (excluding valves & fire hydrants) used, whether shown on plans or not, are considered incidental to the project.

Payment of the unit contract price for the items of work performed shall be the total compensation for furnishing all labor, materials, tools, equipment, specials, fittings, concrete blocking, and incidentals and performing all work that is necessary for the installation in accordance with the plans and the provisions of these specifications.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
3000 (1)	Water Main (All Types)	Linear Foot (LF)

SECTION 3100

TESTING, FLUSHING AND STERILIZATION OF WATER MAINS

3100.1 GENERAL. This section details the requirements for testing, flushing and sterilization of water mains. Water mains may be cleaned as a single segment or in multiple segments, each segment at a maximum of 1200 feet, depending on the total length of the line to be cleaned, the number of different diameter pipe sizes to be cleaned and whether or not butterfly or other restrictive valves are installed in the line.

3100.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. **Most recent version of the references shall be applied.**

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
AWWA C655	Field Dechlorination
AWWA M 9	Concrete Pressure Pipe

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)

3100.3 MATERIALS. All materials shall be furnished and used in accordance with the latest AWWA Standard procedures and this specification for testing pipe, pipe joints and other appurtenances. All pipe and fittings shall be subject to sterilization and hydrostatic pressure testing. Only chemicals approved under applicable state and federal "Safe Drinking Water" and EPA laws, and the AWWA C651, as amended, shall be used for sterilizing water pipe and for dechlorinating flush water. Chlorinating materials shall conform to AWWA B300 and AWWA B301. Swabbing pigs shall be furnished as specified by the piping manufacturer and/or the Engineer. Several swabbing pigs may be required, depending upon the number and diameter size of line segments to be cleaned. Pigs shall be used only once. The Contractor shall be responsible for furnishing any special fittings and adapters that may be required for cleaning, flushing and testing the new pipe, (See STANDARD PLAN No. 3100-1, 3100-2, and 3100-3). When working on existing pipelines, the Contractor shall furnish and install testing stations at no additional cost to the City.

3100.4 CONSTRUCTION. Water mains may be tested, flushed and sterilized as a single segment or in multiple segments. All lines exceeding 1200 ft shall have a sample tap installed in every 1200 ft segment, and one at the end of the line.

Upon completion of the new water main system, the Contractor shall proceed immediately to test, flush

and sterilize it per AWWA C651 requirements. The Contractor shall furnish all labor, materials, tools, and equipment necessary to accomplish these tasks. The City shall draw and test a water sample on the front end of the line to assure the Contractor has a reliable supply of flush water with which to work. The City shall also furnish all water necessary to obtain the first water test sample from the new line and shall conduct the laboratory test. Should the first water sample fail the test, all subsequent water used by the Contractor to obtain a good water test and all subsequent laboratory testing shall be at the Contractor's expense. The quantity of water consumed and billed to the Contractor shall be based on the diameter size and total length of the pipe being tested.

Disinfecting and flushing the line shall be conducted only after successful hydrostatic pressure testing. Then the first of two back to back passing water samples are taken. Consecutive samples must be collected no less than 24 hours apart. Each sample shall be analyzed for turbidity, color, chlorine residual, and coliform bacteria. The line is then placed into service within 72 hours. No line shall be placed into service until two consecutive coliform negative results are received in the laboratory.

The Contractor shall bulkhead and seal newly installed water line to prepare it for testing. Once sealed, he shall fill it with water and raise it to hydrostatic test pressure. The Contractor's site superintendent shall initial the City Inspector's daily log book acknowledging the quantity of water consumed and as agreement to pay for the water used and the laboratory test performed. The Contractor shall ensure that there is no contamination of any existing water lines during cleaning, flushing or testing operations.

3100.4.1 Hydrostatic Pressure Test. Test ductile-iron water mains and water service lines in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600. Test PVC plastic water mains and water service lines in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test concrete water mains in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." The inspector shall supply the laboratory with a completed Disinfection/Hydrostatic Report (Form LA-1) with the initial bacteriological sample. Test steel water mains in accordance with applicable requirements of AWWA C600 for hydrostatic testing. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. During this time the Contractor shall work in close coordination with the inspectors to assure that the water is made safe for public consumption as early as possible. No water mains shall be placed in service until a satisfactory test report has been received from the City's Water Purification Laboratory. The City shall be responsible for the cost of testing the water at the front of the line and the first water sample test at the end of the line. The Contractor shall be responsible for the cost of all subsequent tests.

The Contractor may elect to pressure test against existing valves. However, the City will not guarantee the water tightness of existing valves. Should a new water main be tested against an existing valve and the test fails, the contractor must then disconnect, plug and block the main and install proper blocking and retest the system as provided herein, at his expense.

3100.4.2 Sterilization and Flushing. Sterilization of water lines shall be done in accordance with AWWA C651, as revised and this specification. Prior to sterilizing, each and every valve in the new pipeline shall be pressure tested and flushed, in the full open position, with clear water from the City system to remove all visible evidence of dust, soil, and fine debris which may have entered the line during construction and testing.

Prior to disinfection, obtain the Engineer's approval of the proposed method for disposal of waste water from disinfection procedures. After flushing, water mains 8 inches or larger will be "pigged" with a swabbing pig. Lines with butterfly valves and lines having pipe diameters that vary by more than six inches will have to be "pigged" in separate line segments. This shall consist of totally filling and pressurizing the line.

The Contractor shall furnish all material, labor, equipment to insert, run and remove the "pig" from the main. The pig speed shall be approximately 2 FPS (feet per second) and shall be Girard Type RCC, or approved equal.

After pigging, the Contractor shall install a chlorine discharge assembly on the end of the line, (STANDARD PLAN No. 3100-2). It is essential that the pipe be totally charged with water so that all surfaces, (top, bottom and sides) are fully saturated so that the pig is able to properly scour and clean all surfaces inside the pipe.

Chlorine shall be used to sterilize the pipeline. The amount of chlorine applied shall be such as to provide a dosage of not less than fifty (50) parts per million. The chlorinating material shall be introduced to the water lines and distribution system in a manner approved by the Engineer. After a contact period of no less than 24 hours, the Contractor is to cycle each and every valve in the system (main valves, fire hydrant valves, and any others) two to four cycles to assure that all surfaces and areas are in contact with the high concentration chlorine water in order to kill bacteria and other harmful microbes.

The Contractor shall next flush the high chlorine water from the line with clean water until the residual chlorine content is not less than 0.5 ppm, and not greater than 5.0 ppm. If a total chlorine residual is not detected at each sample tap, the line must be rechlorinated. At this time a valve at the highest point of the line (fire hydrant or other) shall be opened in order to assure that the flush water remains in contact with all inside surfaces of the pipe and that the sterilization process continues through the flushing phase.

Following the flushing phase, the City inspector will sample and test the water for turbidity, chlorine residual and bacterial content of the line. After final flush, there shall be no free chlorine residual present and the total chlorine residual shall be comparable to the water in that area of the distribution system.

3100.4.3 Neutralization & Disposal of Flush Water. Chlorinated water that is flushed from the system and exceeds 7 ppm, must be neutralized before discharging it to the City's municipal storm water drainage system in accordance with EPA, DEQ and City storm water regulations. Dechlorination of the disinfection discharge and flush water shall be in accordance with AWWA C655 standards. No chlorinated water shall be discharged to the environment. The Contractor is responsible for the methods, dosage and monitoring of chemicals used in neutralization.

As appropriate, the Contractor shall notify all applicable regulatory agencies (EPA and DEQ), of the flushing and discharge schedule. The Contractor shall submit disposal and neutralization plans, as required, or when otherwise requested. The Contractor shall supply duplicate copies of the schedules and plans to the Engineer. When and if required, or requested by the regulatory agencies, the Engineer will monitor and report on the Contractor's compliance with respect to the neutralization procedures.

3100.5 MEASUREMENT AND BASIS OF PAYMENT. Payment for test equipment, testing, and sterilization shall be on a lump sum basis.

Payment of the lump sum price for test equipment, testing and sterilization shall be the total compensation for furnishing the chemicals, labor, tools, equipment, and performing the hydrostatic, chlorine content, and bacteriological tests.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
3100(1)	Testing, Flushing and Sterilization of Water Mains	Lump Sum (LS)

SECTION 3200

WATER SERVICE LINES AND METER BOXES

3200.1 GENERAL. The water service line is the pipe connecting the City water main to the customer's meter. It shall consist of a corporation cock or stop at the water main and the pipe or conduit extended to the curb stop connection at the terminal end (Meter box or vault). The service meter box, as herein specified, is the termination point of the City of Shreveport's service liability.

3200.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. All publications are the most recent version unless otherwise noted.

ASTM INTERNATIONAL (ASTM)

ASTM A48	Standard Specification for Gray Iron Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	Standard Specification for Seamless Copper Water Tube
ASTM B145	Copper Alloy Sand Castings for General Applications
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651	Standard for Disinfecting Water Mains
AWWA C655	Field Dechlorination

3200.3 EXISTING SERVICE METER ADJUSTMENT. Existing service meter adjustments shall be required when the existing meter is too low within the meter box. The upper face of the meter shall not exceed the depth of four inches (4") below the meter box lid. The contractor shall furnish and install the applicable length of adjustment riser. All related costs shall be included in the construction costs for the installation of a new service line. The meter riser fitting shall meet the following:

Requires Type- Ford 40 Series Resetter or an approved equal for meter sizes five eighths of an inch (5/8") through one inch (1"). Style & Size: VB42-7WR, VB42-9WR, VB42-12WR, & VB42-15WR, includes styles forty three (43) and forty four (44). VB stands for Ball Valve; forty two (42) stands for Style; seven (7), nine (9), twelve (12), and fifteen (15) stands for height and WR represents the locking device and valve with three hundred and sixty degrees (360°) turn.

3200.4 CONSTRUCTION REQUIREMENTS.

3200.4.1 Water Taps. Water taps and/or tap assemblies of the specified size shall be installed in locations as detailed and indicated on the plans or as specifically noted. Water taps for transmission of potable water from the public water main into customer service lines shall apply to the following:

- A. All service taps applied to PVC, Ductile Iron or Cast Iron water mains shall require an applicable service saddle as identified in this section. Direct taps are prohibited unless otherwise approved by the City Engineer or his authorized representative.
- B. Water tap installations shall be made by clamping a specified circumferential service clamp equipped with a gasket threaded port on to the periphery of the main. Once secured in place, the surface wall of the pipe is core drilled, followed by extracting the bit and port coupon from the main to complete each service port for connection. For HDPE piping, fusible saddle wyes made of PVC shall be used.
- C. Water taps shall be strategically located to provide the shortest distance to the water meter.
- D. All water service taps shall be applied and pressure tested with the water main installation to insure a leak free water system.
- E. Hydrostatic and disinfection testing shall be performed in accordance with AWWA C651 and Section 3100.
- F. Water services will only be provided for within public right-of-way and dedicated servitude.
- G. In accordance with State Plumbing Codes, a licensed plumber is required to perform the private service line work from a private meter to the public water main. However, if the utility work is a city inspected and maintained project within a public right-of-way and/or property servitude, thence a licensed utility contractor is permitted to perform the private service work.
- H. All wet taps on water mains are to be performed by a licensed plumber or licensed utility contractor at his expense. The contractor shall provide all materials, equipment, labor and safe excavation as per City of Shreveport Standards to complete the work.
- I. There shall be no service line joints between the corporation stop at the water main and the service meter, specifically within load bearing surfaces, unless otherwise approved by the City Engineer or his authorized representative.
- J. Service taps shall be applied to the top half of the water main, preferably at a forty five degree (45°) angle maximum. In addition, adjacent service installations along the main shall be installed a minimum three (3) feet apart and a minimum three (3) feet from a water main joint to prevent pipe fracture.

Open trench bottom shall be free from rocks, debris and other foreign objects. The water service installation (bored or open cut) shall be thirty six inches (36") minimum depth below an existing improved street grade or proposed City established street grade shown on the plans. Service lines shall be laid from the corporation stop at the main to the customer meter location at a depth required to clear adjacent ditches. An unimproved roadside ditch shall require a minimum vertical clearance of thirty inches (30") from bottom of ditch and an improved ditch shall require a minimum vertical clearance of eighteen inches (18") from bottom of ditch. Care shall be exercised to maintain the main free of dirt and foreign matter at all times. Copper lines shall be made up in an entirely slack position and shall be free from kinks. Bends shall be no greater than originally found in the coil of tubing as packaged. For one and a half inches (1½") and two inches (2") copper shipped in straight length, use the following bend criteria: For two inches (2")

copper tubing, a maximum forty five degrees (45°) bend may be accomplished in a four feet (4') section; for one and a half inches (1 1/2") copper, forty five degrees (45°) bend in a three feet (3') section.

Meter boxes shall be installed in a dry compacted soil foundation that is free from water or moisture. The meter box shall be level and flush with the ground surface to prevent conflict with mowing, while accommodating any necessary meter adjustments.

3200.5 MEASUREMENT AND BASIS OF PAYMENT. Water service lines, (including meter boxes and risers) shall be measured as per each unit, long or short installed. Service lines installed and accepted, measured as specified, shall be paid for at the contract unit prices established on the Bid Schedule. Payment shall include full compensation for all required labor, products, tools, equipment, plans, transportation and any incidentals related to this item.

<u>ITEM NO.</u>	<u>PAY ITEM</u>	<u>PAY UNIT</u>
3200.4.2(a)	Water Service Line (Up to and including 2" long)	Each
3200.4.2(b)	Water Service Line (Up to and including 2" short)	Each
3200.4.2(c)	Water Service Line (Over 2" long)	Each
3200.4.2(d)	Water Service Line (Over 2" short)	Each

SECTION 3300

FIRE HYDRANTS

3300.1 GENERAL. The work covered under this section shall consist of furnishing and installing Dry-Barrel fire hydrants complete-in-place with valve, extensions and other appurtenances as described herein.

3300.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The latest revisions of these specifications shall apply.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C502	Dry-Barrel Fire Hydrants
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A242	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B98	Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes
ASTM B150	Standard Specification for Aluminum Bronze Rod, Bar, and Shapes

3300.3 ACCEPTABLE HYDRANTS. All fire hydrants furnished shall conform strictly to AWWA Standard for ordinary water works service, AWWA C502 or latest revision, with the following supplementary details.

All fire hydrants furnished under this specification shall be traffic type with a replacement breakaway coupling/fitting joint located approximately three (3) inches, but not more than five (5) inches above the ground line.

Hydrants shall be easy and economical to install and maintain, shall incorporate no parts requiring field adjustment, and shall place the hydrant nozzles a minimum 18" (but not more than 24") above the finished ground line to fully comply with the National Fire Prevention Association's latest edition of Fire Protection Handbook. In the interest of standardization the following brands and models of fire hydrants are acceptable to the City of Shreveport, provided they fully comply with these specifications:

1. Mueller Super Centurian A421
2. M&H Model 129
3. American Darling Mark 73-5
4. American AVK Series 27
5. Clow Medallion F-2545
6. An approved equal

Hydrants shall include two (2) drain outlets. Hydrants shall turn to the left to open (counter clockwise). No hydrant shall be accepted that requires less than ten (10) turns to open. Public hydrants shall be finish painted yellow above ground. Bonnets of private fire hydrants shall be painted reflective white.

3300.4 TESTS AND REJECTION. Hydrostatic tests required in AWWA C 502 shall be complied with and fire hydrants may be rejected for failure to meet any of the requirements of this specification.

3300.5 CONSTRUCTION REQUIREMENTS. Excavation for fire hydrants shall be finished to smooth and uniform surfaces and shall leave the back of trench and bottom of trench undisturbed for concrete blocking. Fire hydrants shall be installed as per standard details at all locations shown in the plans. Each hydrant shall be set upon a slab of stone or concrete not less than four (4") inches thick and not less than (16") inches square of surface area. Where solid rock exists in the bottom of the trench and same is excavated to the proper depth to form a foundation for the hydrant, the slab of stone or concrete above specified may be omitted.

The hydrant shall be set perpendicular to the water main and parallel to the trench walls. Typically, pumper nozzle shall face the street, unless otherwise directed by the Engineer. Hydrants shall be set at such elevation that the connecting pipe will have the same depth of cover as the water main. The back of hydrants shall be carefully and substantially blocked against firm trench walls using 2000 psi concrete, as herein specified to prevent the hydrant joints from blowing off the line due to water hammer upon closing and opening the hydrant.

Seven cubic feet (7 cu. ft.) of sound crushed stone or washed gravel (no pea gravel) shall be placed around the base of the hydrant to allow sufficient voids for completely draining the barrel of the hydrant after closing. The Engineer, at his discretion, may require the installation of a filter fabric to mitigate native soil migration. The fire hydrant shall be set high enough above the finished ground surface to give a minimum clearance of 18" under the nozzle. Any extension required to achieve the 18" nozzle clearance will be considered incidental to the fire hydrant installation. The fire hydrant installation height must not exceed the manufacturer's barrel bury line more than 3-inches, so not to alter the intended function of the traffic breakaway flange.

If a property owner/contractor alters the finished ground surface elevation around a City installed fire hydrant, which decreases the 18" clearance to the nozzles, the property owner/contractor shall be required to pay for extending the fire hydrant to the initial 18" Fire Code ground clearance.

Fire hydrant installations shall maintain a minimum (7) foot clearance from all-weather surfaces (driveways, streets, etc.) unless otherwise approved by the City. This also includes landscaped areas (flower beds, shrubs, etc.). Anyone responsible for obstructing the standard operation of a City fire hydrant is subject to a personal fine under City Fire Code.

3300.6 PROVISIONS FOR EXTENSION. All hydrants shall be capable of being extended to accommodate future grade changes without excavation. Compression type hydrants that close with the flow shall have breakable type stem couplings installed at the ground line flange. Extension of this type hydrant shall be made by adding at the ground line flange a new coupling and stem section equal to the

length of the extension. Stem extensions made by adding a new section of the stem to the threaded section of the stem at the top of the hydrant will not be accepted.

Provision shall be made in the design of the stem to disconnect the stem from the hydrant parts above the stand pipe break point in the event of a traffic accident.

3300.6.1 Gaskets. Gaskets furnished for ground line flanges shall be full face or the flange shall be recessed to hold the gasket in place. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111.

3300.6.2 Breakable or Sleeve Type Couplings. Breakable or sleeve type couplings shall have sufficient torsional strength such that a torsional failure to the stem will occur at some point other than at the coupling. Design of the coupling shall be such that when the coupling is broken, no parts will come loose and fall into the hydrant, and the break will not occur through the pins or bolts holding the coupling to the stem.

3300.6.3 Inlet Connection. Unless otherwise ordered, the inlet connection shall be a 6-inch standard mechanical joint hub complete with all joint accessories. All mechanical joint gland bolts shall be high strength, low alloy, corrosion resistant material, such as Cor-Ten or equal, as specified in ASTM A 242. The inlet valve opening shall be a minimum of 4½ inches.

3300.6.4 Diameter Outlet Connections. Two hose nozzles 2½ inch nominal I.D. One pumper nozzle minimum 4.5-inch nominal I.D.

Minimum hydrant I.Ds of approved manufacturers are listed below:

1. Mueller Super Centurian A421 (4½")
2. M&H Model 129 (4½")
3. American Darling Mark 73-5 (4½")
4. American AVK Series 27 (5¼")
5. Clow Medallion F-2545 (4½")

3300.6.5 Shape and Size of Operating and Cap Nuts. The operating and cap nuts shall be tapered pentagon nuts with faces not less than 1 inch high. They shall be 1-3/16 inch point to face at base and 1-1/8 inch point to face at top.

3300.6.6 Flanges. All flanges shall have a minimum thickness of 7/8-inch. Bolt hole edge distances shall be sufficient to provide full support for the bolt heads and nuts.

3300.6.7 O-Rings. O-rings shall be furnished in lieu of stem packing. They shall be the double O-ring type designed so that the rubber rings will move against a bronze surface.

3300.6.8 Cap Nuts. Hydrants closing with or against the pressure must have a cap nut to seal the bottom end of stem threads against contact with water.

3300.6.9 Hydrant Heads. The hydrant shall be constructed so that the nozzles may be faced in any desired direction.

3300.6.10 Hose and Pumper Nozzle Threads. Hose nozzles shall be 2½ inch, with 3-3/64 inch O.D., and 7½ threads per inch. Pumper nozzles shall have 4 threads per inch (tpi). All nozzles shall be screwed in, not leaded in.

3300.6.11 Gate Valve. A 6-inch gate valve as specified herein shall be installed in the fire hydrant lead as per standard plans. Six inch ductile or cast iron swivel adapters as specified herein shall be installed for fire hydrant leads.

3300.6.12 Valve Boxes and Extension. Cast Iron Valve boxes as specified shall be installed according to STANDARD PLAN 3200-4 for valves exceeding depth of six (6) feet. For all buried valves, valve stem extension shall be provided as necessary to raise 2-inch operating nut to within one (1) foot of the finished grade. Stem diameters shall not be less than 1 inch and according to the manufacturer's recommendations.

3300.7 MEASUREMENT AND BASIS OF PAYMENT. Fire hydrants, installed complete-in-place as shown on the plans and specifications, will be paid for at the unit contract price as provided in the Bid Schedule.

Work completed and accepted under this item, and measured as provided above, will be paid for at the contract unit price bid for fire hydrants, which price shall be full compensation for all materials, including fire hydrants, valves, valve boxes, all extensions, adapters, pipe blocking, stone, filter fabric and any other fittings needed for connection to an in-line tee, labor and supervision necessary to complete the work.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
3300(1)	Fire Hydrants	Each (EA)

SECTION 3400

WATERWORKS VALVES

3400.1 GENERAL. The work to be performed under this section of the specifications shall consist of furnishing and installing gate, wedge, tapping and air release valves and fittings including all excavation, sheeting, shoring, de-watering, testing, backfilling and any other work that is required or necessary to complete the installation as shown in the plans, and as specified herein.

3400.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Most recent version of the references shall be applied.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
AWWA C207	Steel Pipe Flanges for Waterworks Service, Sizes 4-in through 144-in
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C504	Rubber-Sealed Butterfly Valves, 3-in through 72-in
AWWA C509	Resilient Seated Gate Valves for Water Supply Service
AWWA C515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Services
AWWA C550	Protective Epoxy Interior Coating for Valves and Hydrants

ASTM INTERNATIONAL (ASTM)

ASTM A36	Standard Specifications for Carbon Structural Steel
ASTM A126	Standard Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A285	Standard Specifications for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength
ASTM A325	Standard Specifications for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM D429

Standard Test Methods for Rubber
Property-Adhesion to Rigid Substrates

ANSI B16.1

Cast Iron Pipe Flanges and Flanged Fittings:
Classes 25, 125, and 250

MSS-SP-60

Connection Flange Joints between Tapping
Sleeves and Tapping Valves

3400.3 CONSTRUCTION REQUIREMENTS. Valves buried in the ground shall be provided with cast-iron valve boxes of proper dimensions to fit over the valve bonnets and to extend to such elevation at or slightly above the finished ground line as directed by the Engineer. Tops shall be complete with covers and shall be adjustable. Valve boxes shall be set vertical and concentric with the valve stem. A 2000 psi concrete pad of the dimensions shown on the "Typical Valve Box", (STANDARD PLAN No. 3200-4), shall be formed and poured around all valve boxes, unless otherwise directed by the Engineer.

Horizontal Gate Valves shall have a manhole constructed around the operating nut and mechanism. Horizontal valves shall have cast iron inspection plates over gears that are accessible in the manhole. Horizontal Gate Valves shall have a by-pass valve.

In general, installation of a standard air valve shall apply in systems incorporating cast iron pipe, ductile iron pipe, or in pump discharge lines, and combination air and vacuum valves shall be installed where applicable in water distribution or sewer transmission systems. Manholes as per standard details shall be furnished as an integral part of either air release valve or combination air and vacuum release valve installations. Valves shall be bedded and installed in the same manner as the pipe bedding. Installation of Air Release Valve vaults shall be per STANDARD PLAN No. 3400-1.

Backfill for valves shall be compacted as per Section 1002 of these specifications. The top of the valve box shall have a square concrete valve pad two feet by two feet by 6 inches per STANDARD PLAN No.3200-4. The valve pad shall be finished to grade and shall be made of Class "A" Concrete as per specification, "Concrete and Reinforcing Steel".

The valves, unless noted otherwise, shall be designed to operate under an operating pressure of 150 psi (minimum) and shall be tested at twice the design operating pressure. Valves may be rejected for failure to conform to the requirements of this specification.

3400.4 MEASUREMENT AND BASIS OF PAYMENT. Completed and accepted gate valves with boxes, horizontal gate valves with manholes, By-pass valves with boxes, butterfly valves with boxes, air valves with manholes and tapping sleeve and valve with box shall be measured by the unit of one each, of each size and type valve, complete in place.

Work completed and accepted under this specification and measured as provided above, will be paid for at the contract unit price bid, for each size and type valve, including the valve boxes, and manholes in place. The price shall be full compensation for furnishing and installing the valves, boxes, manholes and concrete pads, and for all excavation, backfill, tools, material, labor, equipment and supervision necessary to complete the work.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
3400(1)	Gate Valves including valve boxes & stem extensions	(EA)
3400(2)	Butterfly Valves including valve boxes & stem extensions	(EA)
3400(3)	Air Valves	(EA)
3400(4)	Sleeves and Miscellaneous Work	(EA)

SECTION 3500

WET CONNECTIONS AND APPURTENANCES

3500.1 GENERAL. This section describes the work necessary to perform water tight wet connections to various existing City water mains (4" and up), including any appurtenances necessary to complete the connections as shown on the plans and as specified herein.

3500.2 REFERENCES. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Most updated versions of these publications shall be used.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500

Metal-Seated Gate Valves for Water Supply Service

3500.3 MATERIALS. Wet connections to existing water mains under pressure shall be made with tapping connection fittings in accordance with the manufacturer's recommendations. Tapping valves shall be per AWWA C500 Standards as described herein. Material requirements for valves and fitting shall be as specified in Section 209.

3500.4 CONSTRUCTION REQUIREMENTS. The Contractor shall perform all proposed wet connections on existing City water mains (4" and up) in accordance with Section 3200 and this specification. The Contractor shall be responsible for providing safe trench conditions; cleaning the existing water main thoroughly of foreign matter; assembly of the tapping sleeve & valve in accordance with the manufacturer's recommendations; stabilized blocking behind the pipe sleeve and underneath the tapping valve to support the tapping rig and performing the mechanical tap.

If a pressure test fails and the tapping sleeve & valve application requires alterations, the Contractor is required to immediately notify the City. Contractors are specifically prohibited from operating system valves that control or regulate the City's water main system.

The point of applying the tapping sleeve onto an existing water main shall maintain a minimum distance of three (3) feet from the end-of-sleeve to any existing pipe joint or other fittings, unless otherwise approved by the Engineer.

The contractor shall also be responsible for verifying the exact circumference and roundness of the existing water pipe, to determine the appropriate sleeve size. Any discrepancies between the existing water main and the proposed tapping sleeve or valve application shall be immediately directed to the Engineer.

Once the tapping operation is started, the connection shall be made expeditiously and continuously until completed (No breaks shall be permitted during this operation).

3500.5 MEASUREMENT AND BASIS FOR PAYMENT. Payment for wet connections shall be included in the unit bid price for "tapping sleeve and valve" as listed in the Proposal. All other connections shall be paid for under the unit bid price for water mains.

<u>Item No.</u>	<u>Pay Item</u>	<u>Pay Unit</u>
3500(1)	Tapping Sleeve and Valve	EA

NOTE: This section is very project-specific, and requires more work than just inserting or selecting information indicated by square brackets. This master specification is intended to prompt the specifier by providing suggestions and examples. Insert or select all information indicated by square brackets, including in the Header and Footer, then delete brackets around the item.

SECTION 4010

SUMMARY OF WORK

PART I GENERAL

NOTE: Insert the name and geographical location of project. Be specific, as necessary for this project.

I.01 LOCATION OF WORK

A. The work of this Contract is located at

[_____].

NOTE: Fill in description of work below. List important features of work, description of building, process systems, approximate length and type of piping (for pipework contracts) and other salient characteristics of the Work.

I.02 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and [construct] [install] [perform] [_____] the [_____] in its entirety as shown on the Drawings and as specified herein.

NOTE: Describe major or important items, similar to the description of work in an advertisement for bids.

B. [The Work includes, but is not necessarily limited to, the following:

1. [_____]

2. [_____]

3. [_____]

NOTE: Use following Paragraphs A and/or B and/or C only for work which has been or will be executed by others which is not included in this Contract but is a part of the overall project. An example would be a pile/foundation contract executed prior to the building contract. Reletter as necessary. Delete these paragraphs if they are not applicable.

I.03 WORK BY OTHERS

A. The following work will be performed by others prior to the start of the Work of this Contract.

1. [_____]

2. [_____]

3. [_____]

B. The following work will be performed by others after the completion of the Work of this Contract.

1. [_____]

2. [_____]

3. [_____]

C. The following work will be performed by others concurrently with the Work of this Contract.

1. [_____]

2. [_____]

3. [_____]

NOTE: Use following if City occupancy during construction requires sequential usage of portions of the premises or if certain stages of the Work are critical to completion of other phases. List stages and completion dates. For detailed or complex technical sequences, use Section 4014 Construction Sequence. Delete this paragraph if it is not applicable.

I.04 WORK SEQUENCE

A. Perform Work in sequence listed below to [accommodate City's occupancy during the construction period] [and] [to ensure completion of the Work in the Contract Time]. Completion dates of the various stages shall be [as specified below] [in accordance with the approved construction schedule submitted by the Contractor].

1. [_____]

2. [_____]

3. [_____]

NOTE: Edit following as necessary. Paragraph A is for use with vacant site or unoccupied building being renovated on single contract work when no other parties will use premises during construction. Other paragraphs are for use with an existing facility occupied or operated by the City, such as a treatment plant. Identify maintenance of access for periodic chemical deliveries, for example. Delete this paragraph if it is not applicable.

I.05 CONTRACTOR'S USE OF PREMISES

A. Contractor [will] [will not] have complete and exclusive use of the premises for the performance of the Work.

B. Contractor shall coordinate the use of the premises with the City. Facilities, or Process Units requiring shutdown due to construction related activities shall be coordinated with the City as noted in writing one week prior to taking any Facility or Process Unit out of service.

C. Contractor shall limit the use of the premises for its Work and for storage to allow for:

1. Work by other contractors.

2. City occupancy

3. Public use.
- D. Coordinate use of premises with [other contractors] [Engineer].
- E. Contractor shall assume full responsibility for security of all its subcontractors materials and equipment stored on the site.
- F. If directed by the Engineer, move any stored items which interfere with operations of City or other contractors.
- G. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

NOTE: Use following if the City will occupy site, facility, or building during construction. List specific restrictions for: access to site, parking; use of elevators or other facilities, access to certain areas, etc. Delete this paragraph if it is not applicable.

I.06 CITY OCCUPANCY

- A. City will occupy premises during performance of the Work for the conduct of its normal operations. Coordinate all construction operations with Engineer to minimize conflict and to facilitate City usage.
 1. [_____]
 2. [_____]
 3. [_____]

NOTE: Use following for partial City occupancy. List areas to be occupied and specific dates (if any) coordinate with General Provisions to cover insurance to be covered by respective parties. Delete this paragraph if it is not applicable.

I.07 PARTIAL CITY OCCUPANCY

- A. The Contractor shall schedule its operations so as to complete certain areas of the Work, as designated below, to enable City's occupancy prior to Final Completion of the entire Work.
 1. [_____]
 2. [_____]
 3. [_____]

NOTE: Specify below specific responsibilities for each party such as: maintenance, security, custodial services.

- B. Execute Certificate of Final Completion for each area listed above prior to City's occupancy.
 - I. After City occupancy, Contractor shall allow:
 - a. Access for City's personnel.
 - b. Access for the public.
 - c. Operation of area HVAC, plumbing and electrical systems.

- d. [_____]
- e. [_____]
- 2. After occupancy, City will provide:
 - a. Contractor access as necessary.
 - b. Operation of area HVAC, plumbing and electrical systems.
 - c. [_____]
 - d. [_____]

NOTE: Use the following paragraph only when the City furnishes materials for the Contractor to install. Identify materials, available shop drawings, startup services by others, etc. Identify weights for use in furnishing equipment to unload and handle the materials, estimated delivery dates, storage requirements, etc. Delete this paragraph if it is not applicable.

I.08 CITY-FURNISHED MATERIALS

- A. The City will furnish and pay for the following items:
 - 1. [_____]: Section [_____]
 - 2. [_____]: Section [_____]
 - 3. [_____]: Section [_____]
- B. City's Responsibilities
 - 1. Arrange for and deliver necessary shop drawings, product data and samples to Contractor.
 - 2. [Arrange and pay for delivery of item to site. Coordinate delivery with Contractor.] .
 - 3. [Deliver supplier's bill of materials to Contractor.]
 - 4. Inspect delivery jointly with Contractor.
- C. Contractor's Responsibilities Include but are not limited to:
 - 1. Coordinate delivery date for each pre-purchased item with City.
 - 2. Review shop drawings, product data and samples. Notify Engineer of any discrepancies or problems anticipated with use of pre-purchased item.
 - 3. Receive and unload items at site.
 - 4. Inspect items jointly with Engineer and record any shortages, damaged or defective items.
 - 5. Assume responsibility for items, including insurance, upon acceptance of items at site.
 - 6. Handle items at site, including uncrating and storage. Protect items from exposure to elements and damage.

7. Assemble, install, connect and finish products and provide warranty for Contractor furnished materials and workmanship as specified.
8. Repair or replace items damaged as a result of Contractor's work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NOTE: Use this section for detailed or complex technical sequences, such as modifications to an existing treatment plant. For relatively simple construction sequences, use Paragraph I.04 Work Sequence in Section 4010 Summary of Work. When Section 4014 is used, delete this Paragraph I.04 Work Sequence in Section 4010.

NOTE: This section is very project-specific, and requires more work than just inserting or selecting information indicated by square brackets. This master specification is intended to prompt the specifier by providing suggestions and examples.

SECTION 4014

CONSTRUCTION SEQUENCE

PART I GENERAL

I.01 SITE CONDITIONS

- A. Several areas of construction under this contract must be coordinated with the Operations Personnel and accomplished in a logical order to maintain the process flow and to allow construction to be completed within the time allowed by Contract Documents. Coordinate the activities with the other contractors, if any, to allow orderly and timely completion of all the work.
- B. When access through construction areas must be disrupted, provide alternate acceptable access for the plant operators or other contractors.
- C. Coordinate the activities in the interface or common areas with these other contractors and the field personnel. Submit to the Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors and the field personnel.
- D. Various interconnections may depend on the closure of various valves and gates. [Many of these valves and gates are old and may not seal properly.] Coordinate with the Operations Personnel prior to attempting any such closure and provide any corrective measure of temporary facilities necessary to attain the shut-off needed to perform the work at no additional cost to the City and without interrupting the operation.
- E. Various interconnections may require temporary partial power shutdown. Make every effort necessary to minimize the shutdown time and coordinate with the Operations Personnel and/or utility authorities prior to attempting any such power shutdown. Furthermore, provide any corrective measure or temporary facilities necessary to perform the work at no additional cost to the City and without interrupting the plant operation.
- F. When the work requires an existing facility to be taken out of operation, temporarily or permanently, notify the Engineer in writing 1 week in advance.
- G. Where water is required in large quantity for preoperational testing or other use, purchase it from the City. A meter will be installed at the water source by the City (at the Contractor's request). Pay all fees and water usage charges.
- H. During Start-Up Testing, make available the manpower, equipment and manufacturer's representatives required to make any necessary adjustments and training.

I.02 CONSTRUCTION CONSTRAINTS

- A. The following is a list of constraints to consider in developing the overall plan of construction. This list is not intended to release the Contractor from the responsibility to coordinate the work in any manner which will ensure project completion within the time allowed. The following areas are not necessarily listed in their required sequence of construction. A suggested sequence within each area, where necessary, is included.

- B. []

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NOTE: This specification section needs to be customized for each project.

SECTION 4025

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes requirements for the measurement and payment of various elements of the Work which are not already specified in the Standard Specifications.

NOTE: When not included on the Bid Form, this paragraph may be deleted.

1.02 MISCELLANEOUS CONSTRUCTION ITEMS

- A. Miscellaneous Construction Items, if indicated in the Bid Form, is considered a provisional amount to be used only if needed. Miscellaneous Construction Items are exclusive of work indicated in the Contract Documents for which payment is included under other items in the Bid Form. No work may be performed under Miscellaneous Construction Items without prior written approval of the City Engineer.
- B. Prior to final payment, the original amount provided for Miscellaneous Construction Items will be adjusted to actual costs by deductive Change Order, adjusting the Contract Amount, accordingly.
- C. The Contractor shall make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any unexpended portion of the Miscellaneous Construction Items.
- D. Work authorized by the City under Miscellaneous Construction Items may be performed as a lump sum (negotiated before the fact), unit prices (when applicable), or time and material. For work performed under time and material, Contractor shall submit detailed verification (breakdown) of all costs, subject to the approval of the Engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

NOTE: List every Contract Item – matching the Contract Items in the Bid Form.

NOTE: Provide cross reference to specific Contract Items in the bid form to avoid confusion. If measurement and payment for a Contract Item is specified in the Standard Specifications, refer to the specification and do not repeat those requirements here.

NOTE: The following paragraphs are only for use as examples of content and format. List and describe the actual Contract Items for your project.

3.01 CONTRACT ITEMS

A. ITEM XX-X DUCTILE IRON WATERMAIN AND FITTINGS

I. Measurement

- a. Ductile iron watermain of the size specified on the Bid Form, will be measured in place on a linear foot basis. Measurement for length will be along the horizontal centerline of the pipe, with no deductions for valves or fittings. Locating wires,

identifying tapes, or other markings shall be included in the linear foot measurement, when applicable. Measurement will be to the nearest foot as achieved by tape measure survey over the surface of the alignment.

- b. Cast or ductile iron fittings (tees, bends, crosses, reducers, solid sleeves, etc.) installed in the completed project and as indicated on the Bid Form shall be measured by the pound, excluding cement lining, based on tabular weights obtained from the current ANSI Standards. The weight of the fittings shall not include the weight of glands, bolts, nuts, gaskets or accessories.

2. Payment

NOTE: Separate pay items must be established for each different size, class, and material of pipe.

- a. Payment for furnishing and installing ductile iron pipe of the class and size specified will be made for the respective quantities as above determined, at the price per linear foot entered for the respective item on the Bid Form. Such price and payment shall be full compensation for all related and incidental work, including, but not limited to:

- 1. Surveying and layout;
- 2. utility locates, maintenance of traffic provisions, cutting existing pavement;
- 3. temporary provisions necessary to maintain service;
- 4. dewatering and drainage; furnishing and installing any geotextile filter fabric;

NOTE: Rock and boulder excavation should always be separate pay items.

- 5. trench excavation (excluding rock and boulder excavation); trench support;
- 6. disposal of excess excavated material;

NOTE: Unless the system is restrained at every joint, Restrained Joints should be a separate unit price pay item.

- 7. furnishing, laying and jointing the pipe, including specified restrained joints;
 - 8. underground locating tape, tracer wires, and cathodic protection;
 - 9. backfilling; compaction, restoring the trench surface to grade;
 - 10. restoration (restoring all removed or disturbed physical features to grade, including curbs, sidewalks, driveways, grassing, and landscaping);
 - 11. cleaning, flushing, chlorinating and testing; and,
- b. all other work related or incidental to the installation of underground piping for which separate payment is not provided under other items in the Bid Form.
 - c. Payment for furnishing and installing fittings based on weights as herein specified will be made at the price entered for the respective item on the Bid Form. Price and payment shall be full compensation for furnishing and installing fittings complete with gaskets, glands, bolts, nuts, and all work required for, or incidental to the satisfactory completion of the item for which payment is not provided under other items in the Bid Form.

B. ITEM XX-X VALVES

I. Measurement

NOTE: Generally each type of valve will have a separate bid item

- a. Valves shall be counted as the number of items of each size and type installed.

I. Payment

- a. Payment for valves shall include furnishing and installing the valves, with valve boxes and covers, and valve identification markers. Price and payment will be full compensation for utility locates, maintenance of traffic provisions, cutting existing pavement, excavation (excluding rock and boulder excavation), installation, furnishing and installing restrained joints, backfilling, cleaning, chlorinating and testing, as specified, and all work required for or incidental to the satisfactory completion of the items for which separate payment is not provided under other items in the Bid Form.

C. ITEM XX-X VALVE AND HYDRANT ASSEMBLIES

I. Measurement

- a. Hydrants shall be counted as the number of completed assemblies of each installed.

2. Payment

- a. Payment for hydrants shall include furnishing and installing the completed assembly, including gate valves, with valve boxes, covers, valve tags, concrete pads, and hydrants. Price and payment will be full compensation for utility locates, maintenance of traffic, cutting existing pavement, excavation (excluding rock and boulder excavation), placing screened gravel where required, setting, jointing, providing screened gravel drainage pocket, tie rods, furnishing and installing restrained joints and fittings (or thrust blocks when specified), backfilling, cleaning, chlorinating and testing of hydrant branches, painting (hydrants), pipe bollards, as specified and all work required for or incidental to the satisfactory completion of the items for which separate payment is not provided under other items in the Bid Form.

NOTE: There may be multiple details or sizes of service connections that result in multiple bid items.

D. ITEM XX-X SERVICE CONNECTIONS

I. Measurement

- a. Corporation cocks will be measured as the actual number of each size of corporation stop installed.
- b. Curb stops will be measured as the actual number of each size of curb stops with boxes installed.
- c. Copper pipe for water service connections installed in streets and sidewalk areas will be measured as the actual number of linear feet of each size of tubing installed as measured from the centerline of the water main to the end of the new service line installed and along a straight line projected through these two points at the surface of the ground where the service is installed.

- d. Service meters will be measured as the actual number of each size of meter, including valve box, backflow preventer, and unions (as specified),

2. Payment

- a. Payment for furnishing and installing corporation cocks of the required size will be made for the respective quantities as determined above at the price entered for the respective item on the Bid Form. Price and payment shall be full compensation for all work of furnishing and installing the corporation cocks and appurtenances, utility locates, maintenance of traffic provisions, excavation (excluding rock and boulder excavation), backfilling and all else incidental thereto for which payment is not provided under other items in the Bid Form.
- b. Payment for furnishing and installing curb stops of the required size will be made for the respective quantities as determined above at the price entered for the respective item on the Bid Form. Price and payment shall be full compensation for all work of furnishing and installing the curb stops with boxes, utility locates, maintenance of traffic provisions, all excavation (excluding rock and boulder excavation), backfilling, setting boxes and all else incidental thereto for which payment is not provided under other items in the Bid Form.
- c. Payment for furnishing and installing copper pipe service connections of the required size will be made for the respective quantities as determined above at the price entered for the respective item on the Bid Form. Price and payment shall be full compensation for all work of furnishing and installing the tubing and all required adapters, tapping saddles, reducers, fittings and appurtenances required for executing such connections, chlorinating, utility locates, maintenance of traffic provisions, trench excavation (excluding rock and boulder excavation), dewatering and drainage, driving, and removing trench supports, backfilling, restoring the trench surface to grade, restoring curbing, sidewalks, driveways and other physical features to their original condition, disposal of excavated materials, and all work required for or incidental to the satisfactory completion of the items for which payment is not provided under other items in the Bid Form.

NOTE: When there are multiple types of concrete in the project (i.e., curb, slabs, thrust blocks, etc) that are to be paid by separate unit prices (i.e., not included in other unit items as incidental), separate unit prices will be required for each strength of concrete.

E. ITEM XX-X CONCRETE

1. Measurement

- a. Concrete shall be measured in place in the completed work by average dimensions in each of three planes. Measurement associated with quantities indicated on the delivery ticket will not be allowed.

2. Payment

NOTE: Edit to suit project

- a. Payment for concrete thrust blocks and concrete used for miscellaneous purposes shall be made for the quantity measured in place (cubic yards) at the price entered for the respective item on the Bid Form and shall be full compensation for all work required for, or incidental to the satisfactory completion of the item for which separate payment is not provided under other items in the Bid Form.

F. ITEM XX-X ROCK AND BOULDER EXCAVATION

1. Measurement

- a. When rock is encountered, the material shall be uncovered and the Engineer notified. The Engineer will measure and record a profile of the trench centerline to establish the top of existing rock. If the Contractor fails to uncover the rock and notify the Engineer to allow ample time for profiling the undisturbed rock, the Contractor shall have no right of claim to any classification other than that allowed by the Engineer. Removal of existing concrete, if any, shall be classified as rock. The volume to rock shall be a 'neat line' calculation based on the typical trench detail using the width of the trench and invert of pipe bedding. No payment shall be made for over excavation.
- b. Boulders of more than 1 cu yd. in volume when encountered in earth or trench excavation will be measured for payment as rock. Boulders of 1 cu yd or less shall be considered unclassified excavation.

2. Payment

- a. Payment for rock and boulder excavation will be made for the quantities as above determined, measured in cubic yards, at the price entered for the respective item on the Bid Form, which price and payment will be full compensation for permitting, blasting (if permitted), removal and disposal of rock; backfilling any over excavated volumes; and all work incidental thereto, for which payment is not provided under other items.

G. ITEM XX-X GRAVEL FILL

1. Measurement

- a. Bank run gravel when its use is approved and when furnished, placed and compacted for pavement subbase and for miscellaneous purposes, will be measured in cubic yards at actual in place compacted dimensions as determined by the Engineer. When used for pavement subbase, the maximum width measured for payment shall be as indicated in details on the drawings or elsewhere specified with respect to trench width. Maximum depth measured for payment shall be 1 ft unless otherwise noted in the details on the drawings. No allowance will be made for loss from consolidation of material. Truck measurement or measurement according to delivery tickets will not be permitted. Material excavated from the trench, which is then reused as pavement subbase, will not be measured for payment.
- b. Screened gravel, when used in conjunction with utility crossings and other locations when its use is ordered by the Engineer, will be measured in cubic yards at actual in place dimensions as determined by the Engineer. When used in trenches for pipe bedding in areas where rock is present at the bottom or sides of the trench, the width measured for payment shall not exceed 4.0 ft unless otherwise indicated in the details of the drawings or specifications.

2. Payment

- a. Payment for furnishing and placing bank run gravel and screened gravel will be made for the quantity determined above at the price entered for the respective item on the Bid Form. Price and payment shall be full compensation for furnishing, hauling, placing, and compacting gravel and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

H. ITEM XX-X EXCAVATION BELOW NORMAL SUBGRADE AND [GRAVEL] REFILL

I. Measurement

- a. Measurement of earth excavation and refill below normal trench subgrade, for the removal of unsuitable subgrade or as otherwise directed by the Engineer, will be measured from the bottom of pipe bedding to the actual bottom of excavation. For payment purposes, the allowable trench width shall be in accordance with the standard trench detail. No payment will be made for over excavation.
- b. If the trench bottom is excavated below normal grade requiring refill through error by the Contractor or if the trench bottom is otherwise disturbed by the Contractor through improper drainage or other similar disturbances, such removal and replacement of material will not be measured for payment.

2. Payment

- a. Payment for earth excavation and refill below normal trench subgrade will be made for the quantity as above determined at the price per cubic yard entered for the respective item on the Bid Form. Price and payment shall be full compensation for excavation and disposal of all materials below normal grade, furnishing, placing and compacting screened gravel and all other work incidental thereto for which separate payment is not provided under other items in the Bid Form.

I. ITEM XX-X PAVEMENT REPLACEMENT

I. Measurement

NOTE: Make sure the description matches the specifications.

- a. Temporary trench pavement, 2 in thick Type I I bituminous concrete will be measured for payment in square yards as actually placed, but not exceeding trench widths indicated in the details of the drawings or otherwise specified.

NOTE: Make sure the description matches the specifications.

- b. Permanent trench pavement, 4 in thick Type I I bituminous concrete will be measured for payment in square yards as actually placed, but not exceeding trench widths indicated in the details of the drawings, or otherwise specified.

2. Payment

- a. Payment for trench pavements complete in place, will be made for the quantity determined above at the price entered for the respective item on the Bid Form. Price and payment shall be full compensation for cleaning and preparing the surface of the gravel base, furnishing, placing and maintaining the trench pavement, including labor, materials, calcium chloride for dust control, and all else incidental thereto for which payment is not provided under other items in the Bid Form.

NOTE: Terms for payment of policing should be checked with local authorities and funding agencies to determine if eligible and if these costs can be passed through the Contractor.

J. ITEM XX-X POLICING

I. Measurement and Payment

- a. Payment for special assignments of personnel of the appropriate Police Departments will be made for the actual amount invoiced to the Contractor by the Police Departments. Unit prices established in the Bid Form are for bidding purposes only, and the actual invoiced rates may differ from these established rates. Progress payments will be made based upon receipt of paid invoices, with no Contractor mark-up.

K. ITEM XX-X TEST PITS

I. Measurement and Payment

- a. Measurement of test pits shall be the actual number of test pits ordered by the Engineer and provided by the Contractor. Test pits shall be paid at the price entered for the respective item on the Bid Form for the above determined quantity and shall be full compensation for utility locates, cutting pavement, excavation, backfilling, temporary patching, permanent paving and all other work required for or incidental to the satisfactory completion of this Item.

L. ITEM XX-X MISCELLANEOUS CONSTRUCTION ITEMS

I. Measurement and Payment

- a. This is a lump sum Contract Item for contingency Work, if any, to be identified by the Engineer during construction. Measurement and payment will be identified with authorization to perform Work under this item.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4026

PAY ESTIMATES

PART I GENERAL

I.01 REQUIREMENTS INCLUDED

- A. Pay Estimates will be prepared by the Engineer. Supporting documentation and other items shall be prepared by the Contractor.
- B. Unit Price Work will be measured for payment as specified in Standard Specification Section 111.
- C. Stockpiled or Stored Material will be measured for payment as specified in Standard Specification Section 111. Refer to Standard Specification Section 111.7 for minimum storage period, maximum percentage of contract price, and other requirements.
- D. The accepted Schedule of Values, specified in Technical Specifications Section 4370, will be used as the basis of payment for Contract Items measured by lump sum.

I.02 PREPARATION OF PAY ESTIMATES

- A. Daily reports will be prepared by the Engineer on each working day, listing quantities of Unit Price Work and percentages of work items in the Schedule of Values completed during each working day. Each daily report shall be signed by Engineer and Contractor, to acknowledge agreement on completed Work identified in daily report.
- B. The cutoff date for pay estimates is the last day of each month. The Engineer will prepare the Pay Estimate based on a summary of completed work items recorded on the daily reports each month.

I.03 DOCUMENTATION ASSOCIATED WITH PARTIAL PAYMENTS

- A. Prepare and furnish additional documentation to coincide with each partial payment. The value of each item of required documentation on a monthly basis, established in the approved Schedule of Values or in respective Contract Items, will be included in partial payments whenever the respective item is provided in a timely manner.
- B. After receipt of the first partial payment and prior to receipt of subsequent payments, certify in writing that all subcontractors and suppliers have been paid for work and materials from previous partial payments received (less any retainage) by the Contractor.
- C. On a monthly basis, furnish a completed Monthly Subcontractor Payment and Utilization Report – FSC Form 5 for first-tier and second-tier subcontractors.
- D. On a monthly basis, furnish an updated construction schedule as required in Technical Specification Section 4310.

NOTE: Include the following paragraph if Section 4322 Photographic Documentation is used.

- E. [Provide construction photographs in accordance with Technical Specification Section 4322.]

I.04 STOCKPILED AND STORED MATERIALS

- A. Furnish a monthly summary of stockpiled and stored materials in a format acceptable to the Engineer. Summary shall clearly indicate materials previously installed, materials received and installed during the current month, and net materials on hand during the current month. Summary shall identify the following information.
 - 1. Contract Item number or scheduled item number.
 - 2. Description of specific material
- B. Furnish the following documentation for stockpiled and stored materials
 - 1. Copies of invoices from supplier or manufacturer verifying the cost and quantity of material
 - 2. If storage is on private property, a copy of the lease or agreement granting the Department right of entry to property
 - 3. Certified copies of invoices from the supplier or manufacturer of each item for which payment has been made with the previous payment from the City. All such invoices shall state the amount received by the supplier or manufacturer as payment in full for the materials.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4035

CHANGE ORDER PROCEDURES

PART I GENERAL

I.01 REQUIREMENTS INCLUDED

- A. Promptly implement change order procedures.
 - 1. Provide full written data required to evaluate changes.
 - 2. Maintain detailed records of work done on a time-and-material/ force account basis.
 - 3. Provide full documentation to Engineer on request.
- B. Designate in writing the member of Contractor's organization:
 - 1. Who is authorized to accept changes in the Work.
 - 2. Who is responsible for informing others in the Contractor's employ of the authorization of changes in the Work.
- C. City will designate in writing the persons who are authorized to sign Field Orders, Miscellaneous Construction Authorizations, Work Change Directives, and Change Orders.

I.02 RELATED REQUIREMENTS

- A. Standard Specification Section 100 Definitions and Abbreviations
- B. Standard Specification Section 103 Scope of Work
- C. Standard Specification Section 105 Changes in Work.

I.03 FIELD ORDER

- A. Engineer may issue a Field Order for Contractor to proceed with a minor change which does not involve a change in Contract Amount or Contract Time.
- B. Field Order will describe interpretations or clarifications of Contract Documents, order minor changes in the work, and/or memorialize trade-off agreements. Field Order will describe changes in the Work, both additions and deletions, with attachments as necessary to define details of the change.

I.04 CONTRACT CHANGE REQUEST

- A. City may initiate changes to plans, specifications, character of work, or quantity of work by submitting a Change Proposal Request to Contractor. Request will include:
 - 1. Detailed description of the Change, Products and location of the change in the project.
 - 2. Supplementary or revised Drawings and Specifications.

3. The projected time span for making the change and a specific statement as to whether overtime work is, or is not, authorized.
 4. A specific period of time during which the requested price will be considered valid.
 5. Such request is for information only and is not an instruction to execute the changes, nor to stop work in progress.
- B. Contractor may initiate changes in specified methods of construction and changes to plans and specifications which do not materially affect the Work, and which can be made at a reduction in cost or at no additional cost to the City, by submitting a written Change Proposal to the Engineer, containing:
1. Description of the proposed changes.
 2. Statement of the reason for making the changes.
 3. Statement of the effect on the Contract Amount and the Contract Time.
 4. Documentation supporting any change in Contract Amount or Contract Time, as appropriate.

I.05 DOCUMENTATION OF PROPOSALS AND CLAIMS

- A. Support each quotation for a lump-sum proposal and for each unit price which has not previously been established, with sufficient substantiating data to allow Engineer to evaluate the quotation.
- B. On request, provide additional data to support time and cost computations
1. Labor required.
 2. Equipment required.
 3. Products required.
 - a. Recommended source of purchase and unit cost.
 - b. Quantities required.
 4. Taxes, insurance and bonds.
 5. Credit for work deleted from Contract, similarly documented.
 6. Overhead and profit.
 7. Justification for any change in Contract Time.
- C. Support each claim for additional costs and for work done on a time-and-material/force account basis, with documentation as required in Standard Specification Section 105.3.2 Payment.
- D. Document requests for Substitutions for Products as specified in Section 4630.

I.06 AUTHORIZATION OF CONTRACT CHANGES

- A. City may authorize changes or extra work that involves changes to Contract Price or Contract Time with a Miscellaneous Construction Authorization, a Work Change Directive, or a formal Change Order.

- B. City may issue a Miscellaneous Construction Authorization to authorize changes or extra work with payment from the Miscellaneous Construction Items, if indicated on the Bid Form, and changes to Contract Time. Authorization will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change. It will designate the amount of payment and any change in Contract Time. A Miscellaneous Construction Authorization does not change the Contract Amount or the Contract Time. Authorized changes to Contract Time will be included in a subsequent Change Order.
- C. City may issue a Work Change Directive for Contractor to proceed with a change for subsequent inclusion in a Change Order, either with or without initiating a change by first submitting a Change Proposal Request. Authorization will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change and will designate the method of determining any change in the Contract Amount and any change in Contract Time. A Work Change Directive does not change the Contract Amount or the Contract Time. Changes to the Contract Amount and the Contract Time will be included in a subsequent Change Order.
- D. A formal Change Order is the only document that can change the Contract Amount and the Contract Time. City may issue a Change Order to change the Contract Time as authorized in a Miscellaneous Construction Authorization, to change the Contract Amount and Contract Time as designated in a Work Change Directive, and to authorize extra work and changes initiated by the City.

I.07 METHODS OF COMPENSATION FOR CHANGES

- A. Content of Lump Sum/Fixed Price changes will be based on
 - 1. Engineer's Change Proposal Request and Contractor's responsive Change Proposal as mutually agreed between City and Contractor
 - 2. Contractor's Change Proposal, as recommended by the Engineer
- B. Content of Unit Price changes will be based on
 - 1. Engineer's definition of the scope of the changes
 - 2. Contractor's Change Proposal, as recommended by the Engineer
 - 3. Survey of completed Work
- C. Unit Prices will be those stated in the Contract or those mutually agreed upon between the City and the Contractor.
- D. When the price for changes or extra work cannot be agreed upon, City will issue a Work Change Directive directing Contractor to proceed on the basis of time and materials/force account.
- E. At the end of each day, submit itemized accounting and supporting data as provided in Standard Specification Section 105.3.2.1. Engineer will determine the allowable cost of such work.

I.08 ALLOWABLE COSTS FOR CHANGES

- A. Allowable labor costs consist of payroll costs in the direct employ of the Contractor in the performance of the Work under schedules of job classifications agreed upon by the City and the Contractor. Such employees shall include superintendents, foremen, and

other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by the Contractor, whether at the Site or in the Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedules of job classifications, are excluded from allowable labor costs. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expense of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, may be included in the above to the extent authorized by the City.

- B. Allowable material costs consist of the cost of materials furnished and incorporated into the work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to the Contractor. All trade discounts, rebates, and refunds and returns from sale of surplus materials shall accrue to the City, and the Contractor shall make provisions so that they may be obtained.
- C. Allowable labor costs for Subcontractors are the same as specified for the Contractor.
- D. Allowable equipment costs for owned or rented equipment shall be paid by the following conditions.
 - 1. Allowable rates for owned or borrowed equipment shall be the estimated cost reimbursement rates included within the original bid prices. If the Contractor's established original bid rates are not available, the allowable rates shall not exceed those shown in the Rental Rate Guide Book for Construction Equipment (Blue Book) Volumes 1, 2, or 3 as applicable. If Blue Book rates are used, reimbursement will not be made for owned service trucks or other support equipment and vehicles, since their costs are normally included in equipment operating costs.
 - 2. Owned pickups, if directly used in the performance of extra work, are eligible for reimbursement at the flat rate of \$50.00 per day. If used by a superintendent or used primarily for transportation of employees, their costs are included in overhead and separate reimbursements will not be made.
 - 3. Payment for owned or borrowed equipment will be made for the actual hours used in the extra work. Payment will not be made for time lost for breakdowns, repairs, or time after equipment is no longer needed for the extra work. If equipment is used intermittently while dedicated to the extra work, payment will be made for the duration that the equipment is dedicated to the extra work, but not more than 8 hours per day. While actually working during second and third shift work, payment will be made at one half the Blue Book ownership costs plus the estimated hourly operating costs. No reimbursement will be made while not actually working.
 - 4. If ordered held available for extra work, idled owned or borrowed equipment will be paid for at an hourly standby rate computed as one half of the agreed working rate per hour, excluding operating costs. Reimbursement for standby will not be paid when the equipment would normally be idle, such as Saturdays, Sundays, holidays, days when weather conditions prevent working, during breakdowns or servicing, or when the equipment has actually worked or been paid for 8 or more hours in the day or 40 or more hours in the week.

5. Rental rates for rented or leased equipment shall be as paid by the Contractor. The allowable reimbursement for rented equipment shall be the agreed invoice cost. The invoice shall be marked "PAID" and initialed or signed by the Contractor. Allowable reimbursement for operating costs shall be as agreed between the City and Contractor.

NOTE: For each project, review the following paragraph with the City Engineer for different allowable change markups. I.09.A and I.09.B specify different allowable markups for Lump Sum/Fixed Price changes and Time and Material/Force Account changes. The allowable markup for Time and Material/Force Account changes is lower because the Contractor assumes no risk in pricing the work. Delete I.09.C if I.09.A and I.09.B are used.

I.09 ALLOWABLE MARKUP FOR CHANGES

- A. The Contractor's fee for overhead and profit (markup) for Lump Sum/Fixed Price changes shall be a fee based on the markup provided in Standard Specification Section 105.3.2.4.
- B. The requirements of this paragraph apply to Time and Materials/Force Account changes.
 1. For allowable labor costs, the markup shall be [10] percent.
 2. For allowable material costs, the markup shall be [10] percent.
 3. For allowable subcontractor costs, the markup shall be [5] percent.
 4. For owned, borrowed, or rented equipment, the markup shall be [10] percent.
- C. [The allowable markup for changes is provided in Standard Specification Section 105.3.2.4.]

I.10 CHANGE OF CONTRACT TIME

- A. The Contract Time may only be changed by a Change Order. Changes to Contract Time identified in a Miscellaneous Construction Authorization or a Work Change Directive is evidence that City and Contractor expect that the change will be incorporated into a subsequently issued Change Order.
- B. Where Contractor is prevented from completing any part of the Work within the Contract Time due to delay beyond control of the Contractor, the Contract Time will be extended in an amount equal to the time lost due to such delay.
- C. If anyone for whom the City is responsible delays, disrupts, or interferes with the performance or progress of the Work, then the Contractor will be entitled to an equitable adjustment in the Contract Amount or the Contract Time or both. The Contractor's entitlement to an adjustment is conditioned on such adjustment being essential to the Contractor's ability to complete the Work within the Contract Time.
- D. If the Contractor is delayed in performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under control of the City, or other causes not the fault of and beyond control of City and Contractor, then the Contractor will be entitled to an equitable adjustment in Contract Time, if such adjustment is essential to the Contractor's ability to complete the Work within the Contract Time. Such an adjustment shall be the Contractor's sole and exclusive remedy for the delays described in this paragraph.
- E. For the purpose of this specification, a delay extends the duration of critical path. With any request for changes to Contract Time, the Contractor shall furnish the Engineer with sufficient documented evidence of the impact of a delay to the critical path.

Documentation shall include identifying work activities affected by the delay, demonstrating that the affected work activities are critical path activities, and the impact to the critical path.

- F. With any request for changes to Contract Time for delays related to abnormal weather conditions, the Contractor shall furnish the Engineer with sufficient documented evidence to demonstrate the difference between normal and abnormal weather conditions for the Project location.

I.11 CORRELATION WITH CONTRACTOR'S SUBMITTALS

- A. Periodically revise Schedule of Values to record each change as a separate item of work, and to record the adjusted Contract Amount.
- B. Periodically revise the Construction Schedule to reflect each change in Contract Time.
 - I. Revise subschedules to show changes for other items of work affected by the changes.
- C. Upon completion of work under a Change Order, enter pertinent changes in As-Built Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4038

REQUESTS FOR INFORMATION

NOTE: This Section is complimentary to other Sections. It is intended that the following Sections be included in contract documents along with this Section:

- Construction Schedules - Section 4310
- Submittals - Section 4300
- Project Record Documents – Section 4720

PART 1 GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

- A. This Section specifies the general methods and requirements of Requests for Information (RFIs).

1.02 REQUESTS FOR INFORMATION

- A. When the Contractor believes that additional information or clarification of a contract requirement is needed, they may initiate an RFI.
- B. The RFI process shall be limited to the clarification of technical and/or administrative matters. While the response to an RFI might lead to a change in the contract scope, cost or time, RFIs are not a substitute to the notification requirements stipulated in the General Provisions.
- C. A response to an RFI is not an authorization to perform any additional work that would require a change order or written amendment to the contract. If the Contractor believes the response an RFI requires a change to the Contract, Contractor shall promptly provide written notice to the Engineer in accordance with the General Provisions.
- D. RFIs are not a substitute for the Submittals process specified elsewhere.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 ORIGINATION

- A. The Contactor shall originate RFIs using the form appended to this Section.
 - 1. RFIs shall be numbered consecutively. In the event that an answered RFI results in a follow-up inquiry, the follow-up shall maintain the same number as the original, appended with a suffix.
 - 2. Include Specification Section(s), Drawing(s), or detail(s) for which information is requested.
 - 3. Attach drawings, sketches, photographs or other relevant information.
 - 4. If the question concerns an interpretation of the Contract Documents, enter the Contractor's interpretation.

5. Indicate the date by which the Contractor requests a reply.
 6. Sign the upper portion of the form.
- B. RFIs submitted directly to the Engineer by subcontractors or suppliers will not be accepted. When a subcontractor or supplier generates a request for information or clarification to the Contractor, Contractor shall incorporate such requests into the required format, assign the next number, and sign.
- C. Contractor shall maintain a log of all RFIs including the date originated, date delivered, and date answered.

3.02 PROCESSING

- A. Contractor shall submit all RFIs to the Engineer for processing.
- B. All RFIs will be reviewed and answered by the Engineer.

NOTE: Edit this requirement to suit the project complexity.

- C. The Engineer will generally respond to RFIs within seven calendar days of receipt – depending on the complexity of the inquiry.

3.03 RESPONSES

- A. If the RFI contains sufficient clarity, the Engineer will insert a response in the lower portion of the RFI form, sign and date the response; and, return the completed form to the Contractor.
- B. If the RFI does not contain sufficient clarity, the Engineer may request additional information from the Contractor.
- C. Engineer will maintain a log of all RFIs including the date received and date returned to Contractor.

END OF SECTION
(Standard RFI Form Follows)

Request for Information

Project Name:		
City's Project No.:		Program Project No.:
Contractor:		RFI No.:
		Date:
Subject:		
Spec Section:	Drawing:	Detail:
QUESTION:		
If the above question concerns an interpretation of the Contract Documents, the Contractor's interpretation is: 		
Please Respond by This Date:		
Submitted by Contractor:		Date:
Received by [insert]:		Date:
RESPONSE:		
By:		Date:
Distribution: Contractor, City, Engineer, File, Field, RFI Notebook		

NOTE: This section is very project-specific, and requires more work than just inserting or selecting information indicated by square brackets. This master specification is intended to prompt the specifier by providing suggestions and examples. Caution must be taken when using this Section. Examples were obtained from a previous project. The design or specific project requirements were not removed, and may not be appropriate for your project.

NOTE: This Section deals with existing construction. Coordinate with Electrical, Plumbing and HVAC work and pipe penetration details regarding jurisdiction.

NOTE: Insert or select all information indicated by square brackets, including in the Header and Footer, then delete brackets around the item.

SECTION 4045

CUTTING, CORING, AND PATCHING

PART I GENERAL

I.01 SCOPE OF WORK.

- A. This Section covers the cutting, coring, rough and finished patching of holes and openings. Holes and openings may be in existing construction, or in parts of new construction. Procedures for cutting and patching will be the same for either condition.

NOTE: Verify for project.

- B. All cutting, coring, and finish patching shall be performed by the Contractor. Finish patching is the responsibility of the Contractor and shall be performed by the trade associated with the application of the particular finish.
- C. Provide all cutting, fitting and patching, including attendant excavation and backfill, required to complete the work or to:
 - 1. Make its several parts fit together properly.
 - 2. Uncover portions of the work to provide for installation of ill timed or improperly scheduled work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of Contract Documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Provide penetrations of structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit.
 - 7. Provide penetrations of non-structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit. The determination of what is a nonstructural surface or material shall be made by the Engineer.
 - 8. Remove, install, or relocate materials or equipment.

I.02 SUBMITTALS.

- A. Submit, in accordance with Section 4300, a written request prior to executing any cutting or alteration which is not shown or detailed on the Contract Documents which affects or requires:

1. Cutting structural members.
 2. Holes drilled in beams or other structural members.
 3. Work of the City or any separate contractor.
 4. Structural value or integrity of any element of the project.
 5. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 6. Efficiency, operational life, maintenance or safety of operational elements.
 7. Visual qualities of sight-exposed elements.
- B. Request shall include:
1. Identification of the project.
 2. Description of affected work.
 3. The reason for cutting, alteration or excavation.
 4. Effect on work of City or any separate contractor, or on structural or weatherproof integrity of project.
 5. Description of proposed work:
 - a. Method and extent of cutting, patching, alteration, or excavation.
 - b. Trades who will execute the work.
 - c. Products proposed to be used.
 - d. Extent of refinishing to be done.
 6. Alternatives to cutting and patching.
 7. If the work is considered out of scope, provide a cost proposal.
 8. Confirmation of coordination with any separate contractor whose work will be affected.
 9. Related shutdown requests if required to do the work.
 10. Request for hot work permit if required to do the work.

NOTE: Verify for project.

- C. Submit written notice to the Engineer designating the date and the time the work will be uncovered.

NOTE: Verify for project.

- D. When a written request is required, do not proceed with the work until a written notice to proceed is received from the Engineer.

PART 2 PRODUCTS.

2.01 MATERIALS.

- A. Comply with specifications and standards for each specific product involved. Where there is no equivalent specification, the Contractor shall notify the Engineer who will provide a specification for the materials to be used.
- B. Materials for finish patching shall be equal to those of adjacent construction. Where existing materials are no longer available, use materials with equivalent properties and that will provide the same appearance. The materials are to be approved by the Engineer prior to their use.

PART 3 EXECUTION.

3.01 INSPECTION.

- A. Inspect existing conditions of Project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of products, or performance of work.

NOTE: Verify for project.

- C. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with work until the Engineer has provided further instructions.

3.02 PREPARATION.

- A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.
- B. Protect surrounding materials and equipment prior to starting work.
- C. Contain and control cooling liquids and slurry produced by cutting and coring operations.
- D. When cutting or coring will result in a structure or equipment being exposed, provide adequate weather protection.

NOTE: Confirm Section reference.

- E. Provide dewatering for excavation work in accordance with Standard Specification Section 1004.

3.03 PERFORMANCE.

- A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
- B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work. When excavating in close proximity to piping, duct banks or other items subject to damage, use hand excavation.
- C. All equipment and workplace safety shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.
- D. Where possible, employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.
 2. Sight-exposed finished surfaces.
- E. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
- F. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.
- G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
1. For continuous surfaces, refinish to nearest intersection.
 2. For an assembly, refinish entire unit.
- H. Remove rubble and excess patching materials from the premises.

3.04 CORING.

- A. All coring shall be performed in such a manner as to limit the extent of patching. Locate the rebar before coring to minimize cut-throughs
- B. Coring shall be performed with an approved non-impact rotary tool with diamond core drills.
- C. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
- D. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- E. Fit to pipes and other penetrations in tanks to be water tight using seals or other methods defined in the specifications.
- F. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. All work shall be performed by mechanics skilled in this type of work.
- G. If holes are cored through floor slabs they shall be drilled from below where possible. If holes are drilled from above, provide protection and containment below the area being drilled to catch the plug and contain liquid and slurry.

3.05 CUTTING.

- A. All cutting shall be performed in such a manner as to limit the extent of patching.
- B. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- C. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.
- D. Provide for control of slurry generated by sawing operation on both sides of wall and from below if cutting a floor.
- E. When cutting a reinforced concrete wall or floor, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.

- F. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
- G. Provide equipment of adequate size to remove cut panel.
- H. Saw cut concrete and masonry prior to breaking out sections.
- I. Install work at such time as to require the minimum amount of cutting and patching.
- J. All cutting of structural members shall be done in a manner directed by the Engineer.
- K. Cut opening only large enough to allow easy installation of the equipment, ducting, piping or conduit.
- L. When existing conduits or pipe sleeves are cut off at the floor line or wall line, they shall be filled with grout or suitable patching material.

3.06 PROTECTION.

- A. Provide devices and methods to protect other portions of project from damage.
- B. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work.
- C. Maintain excavations free from water.

3.07 PATCHING.

- A. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.
- B. Finished patching shall match existing surfaces as approved.
- C. Patching shall be of the same kind and quality of material as was removed.
- D. The completed patching work shall restore the surface to its original appearance or better.
- E. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed to include the joint between the existing material and the patch.

NOTE: Verify for project.

- F. Equipment damaged during cutting and patching shall be replaced or repaired by the equipment manufacturer, at the Engineer's sole discretion and at the expense of the Contractor doing the work.

NOTE: Identify Section reference

- G. Repaint any damage to factory applied paint finishes using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted in accordance with the field painting requirements specified in Section [_____] at no additional cost to the City..
- H. Slurry or tailings resulting from coring or cutting operations shall be contained and vacuumed or otherwise removed from the area following drilling or cut.

- I. Equipment shall be protected against mechanical and water damage during cutting and patching. Provide protective covers or use other means such as temporary relocation to protect equipment that is at risk of damage from the cutting and patching
- J. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4050

PROJECT CONTROLS (SURVEYING)

PART I GENERAL.

I.01 SCOPE OF WORK.

- A. Provide and pay for field engineering services required for project; including but not limited to:
 - 1. Survey work required for project controls and layout.
- B. Retain the services of a qualified individual licensed in the state of Louisiana to:
 - 1. Identify existing control points and property line corners indicated on the Drawings.
 - 2. Verify and record the locations of all proposed structures and facilities.

I.02 SUBMITTALS.

- A. Submit, to the Engineer, the name, address and state registration and license number of proposed registered land surveyor.
- B. On request of the Engineer, submit documentation to verify accuracy of field engineering work.
- C. For roadways, compute and furnish template grades to the Engineer as soon as possible in order to obtain pipe lengths in an orderly manner.

I.03 QUALIFICATIONS OF SURVEYOR.

- A. Individuals performing construction layout or cadastral surveying shall meet the qualifications established by the laws and rules of the Louisiana Professional Engineering and Land Surveying Board.

I.04 SURVEY REFERENCE POINTS.

- A. The City will provide reference points which in the Engineer's judgment are necessary to enable the Contractor to proceed with the Work.
- B. Locate and protect reference points prior to starting site work and preserve all permanent reference points during construction.
 - 1. Make no changes or relocations without prior written notice to and approval by the Engineer.
 - 2. Report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
 - 3. Require the surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control.

I.05 PROJECT SURVEY REQUIREMENTS.

NOTE: For pipeline projects consider requiring additional temporary benchmarks such as one for each mile of pipeline.

- A. Establish a minimum of two temporary benchmarks on site, referenced to data established by survey control points.
 - 1. Record locations, with horizontal and vertical data.
 - 2. Temporary benchmarks shall be installed and spaced for convenient reference and used at locations along roadways, pipeline routes, and/or on the Site.

NOTE: Permanent benchmarks are typically unnecessary. Consider requiring permanent benchmarks for new facilities, such as a plant or major pump station.

- B. [Establish a permanent benchmark(s) at locations shown on the Drawings. Permanent benchmarks shall be installed to National Geodetic Survey standards and shall include horizontal and vertical data, as well as the installation date.]

NOTE: Edit the following paragraph as necessary for each project. Be specific on how you want the project layed out.

- C. Establish lines and levels; locate and lay out:
 - 1. Site improvements.
 - a. Stakes for grading, fill and topsoil placement.
 - b. Utility slopes and invert elevations.
 - c. Sidewalks, pavement, fencing, storm drainage facilities, and other finish surface work.
 - 2. Batter boards for structures.
 - 3. Building foundation, column locations and floor levels.
 - 4. Controlling lines and levels required for mechanical and electrical trades.
- D. If lines, levels or layouts are lost or destroyed, or if required by the Engineer, verify layouts by same methods.
- E. Establish all lines and grades prior to construction of line work for all force mains, transmission mains, storm drainage piping, gravity sewers and other new utility lines at 100-ft increments, at defined breaks in grade, and at manholes.

PART 2 PRODUCTS. (NOT USED)

PART 3 EXECUTION.

3.01 RECORDS.

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Record lines and grades in numbered notebooks furnished by the City.
 - I. At the end of the project, and prior to final payment, submit properly indexed and cross-referenced notebooks to the Engineer.

END OF SECTION

SECTION 4110

STORM WATER PERMITTING PROCEDURES

NOTE: Caution must be taken when using this Section. This section specifies procedures for the requirement in Standard Specification Section 310.01 for the contractor to prepare an Erosion Control Plan or a SWPPP. Current City practice is preparation of these documents by the design engineer. Consult with the City Engineer before using this specification on any project

PART I GENERAL

I.01 SCOPE OF WORK

- A. Furnish all labor and professional services necessary to prepare an Erosion Control Plan or Storm Water Pollution Prevention Plan (SWPPP) for use in compliance with storm water permit requirements.
 - 1. Prepare an Erosion Control Plan for Work where less than one acre of land will be disturbed by construction activities.
 - 2. Prepare a SWPPP for Work where one or more acres of land will be disturbed by construction activities.
- B. The City will prepare and submit a Notice of Intent and a Notice of Termination.
- C. Refer to Standard Specification Section 310 for requirements to construct and maintain temporary erosion control features.

I.02 APPLICABLE REGULATIONS

- A. Comply with all applicable Federal, State and local laws and regulations concerning storm water permitting.
 - 1. City of Shreveport Code of Ordinances Article IV – Erosion and Sediment Control
 - 2. LAC 33:IX.2511.B.15 (for ground disturbance area 1 acre to less than 5 acres)
 - 3. LAC 33:IX.2511.B.14.j (for ground disturbance area 5 acres or more)
 - 4. Title 40 CFR 123.5(a)(9), 122.26(a), 122.26(b)(14)(x) and 122.26(b)(15)

I.03 SUBMITTALS

- A. Submit 6 copies of the Erosion Control Plan or SWPPP to the City before commencing land-altering activities including clearing, grading, excavating and filling.

I.04 EROSION CONTROL PLAN

- A. The Permit Application and Erosion Control Plan shall satisfy requirements of Shreveport Code of Ordinances Section 34-123
- B. The Permit Application and Erosion Control Plan shall include the following items.
 - 1. Grading and drainage plan showing
 - a. Date, scale, north arrow, and property lines

- b. Location, type of use, and total percentage of existing and proposed improvements
 - c. Existing and proposed topographic features
 - d. Locations of all temporary and permanent runoff detention basins, along with any constructed and/or altered drainage systems
- 2. Erosion Control Plan showing
 - a. Description of temporary and permanent structural controls
 - b. Temporary and final stabilization
- 3. Schedule providing for site inspections at least every 2 weeks and after each rain event of ½ inch or more
- 4. List of measures to minimize offsite tracking of sediment on vehicles
- 5. Sequence of scheduled activities
- 6. The 100-year floodplains and/or floodways with related elevations

I.05 STORMWATER POLLUTION PREVENTION PLAN

- A. The SWPPP shall satisfy requirements of Louisiana DEQ Storm Water General Permit for Small Construction Activities or Louisiana DEQ General Permit for Discharges of Storm Water From Construction Activities 5 Acres or More.
- B. The SWPPP shall include the following contents as described in the respective General Permit.
 - 1. Site Description
 - 2. Controls
 - 3. Maintenance
 - 4. Inspections
 - 5. Non-Storm Water Discharges
 - 6. Certification and Signature

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 STORM WATER POLLUTION PREVENTION PLANS

- A. Post a notice near the main entrance to the construction site with the following information.
 - 1. The LPDES permit number and effective date of the permit
 - 2. The name and telephone number of a local contact person
 - 3. A brief description of the project

4. Location of the SWPPP if the site is inactive or does not have an on-site location to store the plan
- B. Make the SWPPP available on request to LDEQ, local government officials, and the operators of a municipal separate storm sewer receiving discharges from the site.
- C. Amend the SWPPP as described in the respective General Permit whenever:
1. there is a change in design, construction, operation, or maintenance, which has a significant effect on the discharge of pollutants to the waters of the State and which has not otherwise been addressed in the SWPPP.
 2. inspections or investigations indicate the SWPPP is proving ineffective or otherwise not achieving the general objectives of controlling pollutants in storm water discharges associated with construction activity
 3. a new contractor or subcontractor will implement a measure of the SWPPP
 4. measures are necessary to protect endangered and threatened species or historic properties.

END OF SECTION

SECTION 4200

PROJECT MEETINGS

NOTE: Edit this section for each project. Specify meeting attendees and agenda items as appropriate.

PART I GENERAL

I.01 REQUIREMENTS INCLUDED

- A. The Engineer will schedule and administer pre-construction meeting, periodic progress meetings and specially called meetings throughout progress of the Work.
 - 1. Prepare agenda for meetings.
 - 2. Make physical arrangements for meetings.
 - 3. Preside at meetings.
 - 4. Record the minutes; include significant proceedings and decisions.
 - 5. Reproduce and distribute copies of minutes within 15 working days after each meeting.
 - a. To participants in the meeting.
 - b. To parties affected by decisions made at the meeting.
- B. Representatives of Contractors, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. Attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

I.02 PRE-CONSTRUCTION MEETING

- A. Attend a preconstruction meeting.
- B. Location: A central site, convenient for all parties, designated by the Engineer.
- C. Attendance
 - 1. Engineer and his/her professional consultants.
 - 2. Resident Project Representative.
 - 3. Contractor.
 - 4. Major Subcontractors.
 - 5. Major suppliers.
 - 6. Utilities
 - 7. Others as appropriate.
- D. Suggested Agenda Items

1. Introduction of key project personnel
2. Lines of communication/procedures
3. Preconstruction submittal requirements
4. Key contract dates
5. Correspondence routing and distribution
6. Payment procedures
7. Submittal and shop drawing procedures
8. Project progress meetings
9. Project progress reports
10. City requirements and special project procedures
11. RPR duties, responsibilities, and limitations of authority
12. Permits and coordination with local building officials
13. Safety procedures
14. QM procedures
15. Construction work schedule (days, hours, holidays, overtime)
16. Control of work requirements
17. Fair Share reporting requirements (Form 5)
18. Material storage requirements
19. Contractor's staging area
20. Field Offices
21. Coordination with utilities
22. Homeowner/business notification and citizen complaints
23. Construction photographs and record drawings
24. Testing laboratory procedures
25. Conformed documents

I.04 PROGRESS MEETINGS

- A. Attend periodic meetings at regular intervals determined by the Engineer.
- B. Attend called meetings as required by progress of the Work.
- C. Location of the meetings: Project field office of Contractor or Engineer, or City Hall, or another location identified by the Engineer.

D. Attendance

1. Engineer and his/her professional consultants as needed.
2. Subcontractors as appropriate to the agenda.
3. Suppliers as appropriate to the agenda.
4. Others as appropriate.

E. Suggested Agenda Items

1. Review, approval of minutes of previous meeting.
 2. Review of work progress since previous meeting.
 3. Submittals
 4. RFI's
 5. Field Orders, Work Change Directives, Change Orders
 6. Field observations, problems and conflicts.
 7. Current Construction Schedule.
 8. Progress, schedule, during succeeding work period.
 9. Coordination of work activities.
- F. Attend progress meetings and study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the Work, etc.
- G. Provide a current submittal log at each progress meeting.
- H. Provide an updated and accurate project schedule of work to be performed in the next 30 days.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4300

SUBMITTALS

NOTE: Edit text carefully to delete details not appropriate to Project.

NOTE: This Section is complimentary to several other Sections. It is written for the following Sections be included in contract documents with this Section:

Operation and Maintenance Manuals - Section 4730

Contract Closeout - Section 4700

Warranties and Bonds - Section 4740

Photographic Documentation – Section 4322

Pay Estimates - Section 4026

Construction Schedules - Section 4310

Requests for Information - Section 4038

PART I GENERAL

I.01 SCOPE OF WORK

- A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the project.
- B. Submittals are categorized into two types: Action Submittals and Informational Submittals, as follows:
 - I. Action Submittal: Written and graphic information submitted by the Contractor that requires the Engineer's approval. The following are examples of action submittals:
 - a. Shop drawings (including working drawings and product data).
 - b. Samples.
 - c. Operation & maintenance manuals.
 - d. Site Usage Plan (Contractor's staging - including trailer siting and material laydown area).
 - e. Schedule of values Pay Estimate format.
 - f. Construction Schedule.
 - g. Outage Requests.
 - h. Vendor Training Outlines/Plans.
 - i. As-Built Drawings.
 - j. Warranties and Bonds.
 - k. Contract Close-out documents.

NOTE: This list may be expanded to suit specialized projects, or additional project requirements. However, there is no intent or necessity for this list to be all-inclusive.

2. Informational Submittal: Information submitted by the Contractor that does not require the Engineer's approval. The following are examples of informational submittals:
 - a. Shop Drawing Schedule.
 - b. Statements of Qualifications.
 - c. Health and Safety Plans.
 - d. Construction Photography and Videography.
 - e. Work Plans.
 - f. Maintenance of Traffic Plans.
 - g. Proposed Testing Procedures.
 - h. Test Records and Reports.
 - i. Test and Start-Up Reports.
 - j. Certifications.
 - k. Record Shop Drawings.
 - l. Submittals required by laws, regulations and governing agencies.
 - m. Submittals required by funding agencies.
 - n. Other requirements found within the specifications.

I.02 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall prepare and submit, at no additional cost to the City, submittals and details of structural and reinforcing steel, equipment, materials, electrical controls, architectural fabrications, pipe, pipe joints, special pipe sections, valves, pumps, mix designs, design/build documents, and other appurtenances, as required in the technical specifications.

All submittals and supporting data, catalogs, schedules, etc., shall be submitted as the instruments of the Contractor, who shall be responsible for their accuracy, completeness, and coordination. Such responsibility shall not be delegated, in whole or in part, to subcontractors or suppliers. These submittals may be prepared by the Contractor, subcontractors, or suppliers, but the Contractor shall ascertain that submittals meet all of the requirements of the Contract Documents, while conforming to structural, space, and access conditions at the point of installation. Designation of work "by others," if shown in submittals, shall mean that the Work will be the responsibility of the Contractor rather than the subcontractor or supplier who prepared the submittals. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where its submittal may affect the work of another Contractor of the City. The Contractor shall ensure coordination of submittals among the related crafts and subcontractors.

Submittals shall be prepared in such form that data can be identified with the applicable specification paragraph. The data shall clearly demonstrate compliance with the Contract Documents and shall relate to the specific equipment or piece of work to be furnished.

Where manufacturer's standard drawings and catalog sheets are employed, they shall be marked clearly to show what portion of the data is applicable to this project.

NOTE: Select a version of the following paragraph to match City preference for electronic transmission or hard copies.

B. Transmittal Procedures:

[All submittals will be transmitted electronically from the Contractor through the City's Project Management Information System (PMIS) via the internet. Training on the PMIS will be provided to the Contractor free of charge prior to the start of the project. Ongoing training and support to the Contractor and their subcontractors will also be provided.].

[Electronic transmission of submittals is not acceptable. Transmit the specified number of hard copies to the Engineer.].

C. Submittal Registry:

The Contractor will submit a submittal registry listing all proposed submittals for the project to the City at, or before the pre-construction meeting. The submittal registry will include, but not limited to; technical shop drawings, samples, project baseline schedule and monthly updates, schedules, schedule of values, permit requirements, test results and certifications, operations and maintenance manuals, shutdown/outage requests, vendor training outline/plans, warranties and bonds, record drawings, and spare parts. After review and approval of the submittal registry, the City will load the list of submittals onto the PMIS.

The Submittal registry list will have the following information:

1. Submittal Number – The submittal number will be made up of a six digit number, a period, and the two digit number (XXXXXX.XX). The first six digit number is the applicable specification section. The two digit number after the period is the sequential number for each item to be submitted under each specification section, in chronological order submitted, starting at .01.
2. Submittal Description – A description of what the submittal contains, or a list of items included in the submittal.
3. Vendor Name – Name of manufacturer, vendor, or subcontractor supplying the item in the submittal.
4. Substitution – Indicate if the item being submitted is a substitution from the specified product or vendor.
5. Submittal Date – Indicate the anticipated date for transmitting the submittal to the City.
6. Example:

Submittal #	Description	Vendor	Substitution	Date
221005.01	Ball Valves	Milwaukee	No	03/24/15

D. All submittals shall be clearly identified as follows:

1. Date of Submission.

2. Project Number.
 3. Project Name.
 4. Contractor Identification.
 - a. Contractor.
 - b. Vendor or Supplier
 - c. Manufacturer.
 5. Identification of the Product.
 6. Reference to Contract Drawing.
 7. Reference to specification section number, page and paragraph(s).
 8. Reference to Contract Item number.
 9. Reference to applicable standards, such as ASTM or Federal Standards numbers.
 10. Indication of Contractor's approval.
 11. Contractor's Certification statement.
 12. Identification of deviations from the Contract Documents, if any.
 13. Reference to previous submittal (for resubmittals).
- E. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.
- F. Variances
1. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.
 2. Notify the Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Engineer.
- G. Action Submittals.
1. Shop Drawings
 - a. Shop drawings may include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.
 - b. Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.
 - c. All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the

work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.

- d. All shop drawings submitted by subcontractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and confirm that the submittal is coordinated and compatible with existing conditions. Submittals directly from subcontractors or vendors will not be accepted by the Engineer.
- e. The Contractor is responsible for the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the Contractor's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor or vendor to correct, before submission to the Engineer. All shop drawings shall be approved by the Contractor.
- f. Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contractor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contractor's control.

2. Working Drawings

- a. Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.
- b. Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.
- c. Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.
- d. Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.

- 3. Product Data: Product data include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

4. Samples.

- a. Furnish, samples required by the Contract Documents for the Engineer's approval. Samples shall be delivered to the Engineer as specified or directed.

Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Engineer.

- b. Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and other specified units of work.
- c. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any Contract Requirements.
- d. Approved samples not destroyed in testing shall be sent to the Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so requested at time of submission.

5. Contractor's Certification.

- a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:

"Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."

- b. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package.

- 6. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.
- 7. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation of products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Engineer will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- 8. Operation and Maintenance Data: Operation and maintenance data shall be submitted in assembled manuals as specified. Such manuals shall include detailed instructions for City personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

9. Schedule of Values: On projects consisting of lump sums (in whole or in part) submit a proposed schedule of values providing a breakdown of lump sum items into reasonably small components – generally desegregated by building, area, and/or discipline. The purpose of the schedule of values is for processing partial payment applications. If requested by the Engineer, provide sufficient substantiation for all or some items as necessary to determine the proposed schedule of values is a reasonable representation of the true cost breakdown of the Work. The schedule of values shall not be unbalanced to achieve early payment or over-payment in excess of the value of work or any other inequitable distribution of the costs. If, in the opinion of the Engineer, the schedule of values is unbalanced, Contractor shall reallocate components to achieve a balanced schedule acceptable to Engineer.
10. Site Usage: Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable.

H. Informational Submittals

1. Shop Drawing Schedule: Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.
2. Construction Schedule: Prepare and submit construction schedules and monthly status reports as specified.
3. Statements of Qualifications: Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.
4. Health and Safety Plans: Prepare and submit a general company Health and Safety Plan (HASP) modified or supplemented to include job-specific considerations;
5. Construction Photography and Videography: Provide periodic construction photographs and videography as specified in Section 4322 – including preconstruction photographs and/or video, monthly progress photos and/or video and post-construction photographs and/or video.
6. Work Plans: Prepare and submit copies of all work plans needed to demonstrate to the Engineer that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.
7. Maintenance of Traffic Plans: Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If Contractor is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.
8. Outage Requests: Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities.

Unless specified otherwise elsewhere, a minimum of seven calendar days' notice shall be provided.

9. Test Records and Reports: Provide copies of all test records and reports as specified in the various technical specifications.
10. Vendor Training Outlines/Plans: At least two weeks before scheduled training of City personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.
11. Test and Start-up Reports: Manufacturer shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Section. Provide copies of all such test and start-up reports.
12. Certifications.
 - a. Provide various certifications as required by the specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity.
 - b. Certifications may include, but are not limited to:
 - i Welding certifications and welders qualifications
 - ii Certifications of Installation, Testing and Training for all equipment
 - iii Material Testing reports furnished by an independent testing firm
 - iv Certifications from manufacturer(s) for specified factory testing
 - v Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents
13. As-Built Drawings: No later than Final Completion, submit a record of all changes during construction– in accordance with specification on As-Built Drawings.

NOTE: Delete Paragraph 14 and its subparagraphs if not required.

14. Documentation Required By Others.
 - a. Submittals required by laws, regulations and governing agencies.
 - i. Prepare and submit all documentation required by state or local law, regulation or government agency directly to the applicable agency. This includes, but is not limited to, notifications, reports, certifications, certified payroll (for projects subject to wage requirements) and other documentation required to satisfy all requirements. Provide to Engineer one copy of each submittal made in accordance with this paragraph.
 - b. Submittals required by funding agencies.
 - i. Prepare and submit all documentation required by funding agencies. This includes, but is not limited to segregated pay estimates and change orders when required to properly allocate funds to different funding sources; and certified payrolls for projects subject to wage requirements. Provide one copy of each submittal made in accordance with this paragraph to the Engineer.

15. Warranties and Bonds: Assemble a booklet or binder of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds; and provide two originals to the Engineer.
16. Contract Close-Out Documents: Submit Contract documentation as indicated in the specification for Contract Closeout.

PART 2 PRODUCTS (NOT USED).

PART 3 EXECUTION.

3.01 SUBMITTAL SCHEDULE.

- A. Provide an initial submittal schedule for review by the Engineer. Incorporate comments from Engineer into a revised submittal schedule.
- B. Maintain the submittal schedule and provide sufficient copies for review by Engineer. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

- A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: the Contractor's name and address, Engineer's name, project name, project number, submittal number, description of submittal and number of copies submitted.
- B. Submittals shall be transmitted or delivered directly to the office of the Engineer, as indicated in the Contact Documents or as otherwise directed by the Engineer.
- C. Provide copies of transmittals forms or cover letters (without attachments) directly to the Resident Project Representative.

3.03 PROCEDURES

- A. Action Submittals
 - I. Contractor's Responsibilities
 - a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.
 - b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including the specified review time for the Engineer.

NOTE: Confirm turnaround time and edit to suit project needs.

- c. Engineer will be allowed a reasonable time within which to evaluate each submittal for shop drawings and O&M manuals that require review by more than one engineering discipline. Resubmittals will be subject to the same review.

- d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).
- e. Before submission to the Engineer, review shop drawings as follows:
 - i. make corrections and add field measurements, as required
 - ii. use any color for its notations except red (reserved for the Engineer's notations) and black (to be able to distinguish notations on black and white documents)
 - iii. identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the Engineer on a previous submission
 - iv. include the required Contractor's Certification statement
 - v. provide field measurements (as needed)
 - vi. coordinate with other submittals
 - vii. indicate relationships to other features of the Work
 - viii. highlight information applicable to the Work and/or delete information not applicable to the Work

NOTE: Use this paragraph if hard copies are required, and edit the number of copies as needed. Delete this paragraph if electronic transmission is required.

- f. Submit the following number of copies:
 - i. Shop drawings (including working drawings and product data) – Submit no fewer than [], [] of which will be retained by the Engineer.
 - ii. Samples – []
 - iii. Site Usage Plan – [] copies
 - iv. Schedule of values – [] copies
 - v. Pay Estimate format – [] copies
- g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the Engineer immediately; and do not release for manufacture before such notice has been received by the Engineer.
- h. When the shop drawings have been completed to the satisfaction of the Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Engineer.

2. Engineer's Responsibilities

- a. Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.

- b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Engineer indicating the deficiencies requiring correction.
- c. If shop drawings (including working drawings and product data) meet the submittal requirements, Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action - with the Engineer retaining one copy.

NOTE: Insert the number of days for review based on individual project requirements. Shop drawings that must be reviewed by more than one engineering discipline will require more time for review.

- d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Engineer within [] days. The time for review will commence upon receipt of submittal by Engineer.
3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples
- a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 - i. as permitting any departure from the Contract requirements
 - ii. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials
 - iii. as approving departures from details furnished by the Engineer, except as otherwise provided herein
 - b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
 - c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Engineer are in the interest of the City and are so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
 - d. Only the Engineer will utilize the color "RED" in marking submittals.
 - e. Shop drawings will be returned to the Contractor with one of the following codes.
 - i. "APPROVED" – This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the material for manufacture.
 - ii. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required. The Contractor

may release the material for manufacture; however, all notations and comments must be incorporated into the final product.

NOTE: Edit the number of days required for confirmation to suit the project complexity and duration.

- I. "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a written confirmation of the notations and comments is required. The Contractor may release the material for manufacture; however, all notations and comments must be incorporated into the final product. Written confirmation shall specifically address each notation and comment. Confirmation shall be furnished to the Engineer within [15] days of the date of the Engineer's transmittal requiring the confirmation.

NOTE: Edit the number of days required for resubmittal to suit the project complexity and duration.

2. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when a written confirmation of the notations and comments is required and are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal shall be furnished to the Engineer within [30] days of the date of the Engineer's transmittal requiring the resubmittal.
3. "NOT APPROVED" – This code is assigned when the submittal does not meet the intent of the contract documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor.
4. "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional information to aid the Contractor.
5. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.
- f. Repetitive Reviews: Shop drawings, O&M manuals and other submittals will be reviewed no more than [2] times at the City's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the City for all costs invoiced by Engineer for the [third] and subsequent reviews.

NOTE: Generally, e-mail is not sufficient for the electronic transmission of submittals due to file size limitations imposed by mail servers. Delete this paragraph if electronic transmission is not acceptable.

- g. Electronic Transmission: Action Submittals shall be transmitted by electronic means, meeting the following conditions:
 - i. The above-specified transmittal form is included.
 - ii. All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contactor, and the Contractor's Certification.
 - iii. The submittal contains no pages or sheets larger than 11 x 17 inches.

- iv. With the exception of the transmittal sheet, the entire submittal is included in a single file.
- v. The electronic files are PDF format (with printing enabled).

NOTE: Confirm number of hard copies required.

- 1. [In addition,] transmit [] hard-copy (paper) originals to the Engineer.
- 2. The Engineer's review time will commence upon receipt of the hard copies of the submittal.
- 3. For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least [] hard-copy originals to the Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals

- 1. Contractor's Responsibilities
 - a. Number of copies: Submit [one] [copy] [copies], unless otherwise indicated in individual Specification sections
- 2. Engineer's Responsibilities

NOTE: Confirm number of days required.

- a. The Engineer will review each informational submittal within [] days. If the informational submittal complies with the Contract requirements, Engineer will file for the project record. Engineer may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.

NOTE: Confirm number of days required.

- b. If an informational submittal does not comply with the Contract requirements, Engineer will respond accordingly to the Contractor within [] days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Engineer, is in conformance with the Contract Documents.

NOTE: Delete this paragraph if electronic transmission is not acceptable.

- 3. Electronic Transmission
 - a. Informational submittals shall be transmitted by electronic means meeting all of the following conditions:
 - i. The above-specified transmittal form is included.
 - ii. The submittal contains no pages or sheets larger than 11 x 17 inches.
 - iii. With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - iv. The electronic files are PDF format (with printing enabled).

- v. For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit two hard-copy originals to the Engineer.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

NOTE: This Section specifies a CPM Schedule intended for typical City projects. The requirements provide for float sharing, which is the commonly recognized industry standard.

SECTION 4310

CONSTRUCTION SCHEDULING

PART I GENERAL

I.01 REQUIREMENTS INCLUDED

- A. The Contractor shall prepare and submit to the Engineer for review, a schedule that clearly shows the sequence and interdependencies of activities required for complete performance of the work required for this project, showing the order in which the Contractor and his Subcontractors propose to carry on the Work, and the dates upon which he proposes to start and complete the entire scope of work, including the dates for submittals and approval of samples and shop drawings, and the procurement of materials, plant, and equipment. The construction schedule shall consist of a critical path method (CPM) network presented in a time-scaled graphic (print-out).
- B. The construction schedule shall, in general, determine the order in which the Work is to proceed. The Engineer shall review the Contractor's approach to meet the specific requirements.
- C. The Contractor will be responsible for coordinating his own schedule as well as construction activities of others directed by his Subcontractors. The schedule shall include activities to be performed by Subcontractors and will demonstrate the coordination of their work. The contractor will maintain the overall project construction schedule, of which the Sub-contractor's construction schedule will be a part.
- D. The Contractor shall furnish sufficient forces, construction equipment as may be necessary to complete the Work in accordance with the submitted schedule.
- E. The Contractor shall designate the individual or an authorized representative who shall be responsible for development and maintenance of the schedule and reports. This individual or representative of the Contractor shall have direct project control and complete authority for updating and maintaining the Contractor's schedule.
- F. Contract Time on a Working Day Basis or a Calendar Day Basis extends from the date of Notice to Proceed through the date of Final Completion. All Work, including activities such as testing, startup, training, 30-day performance tests, O&M Manuals, warranties, As-Built Drawings, etc. must be completed within the Contract Time. All Work shall be identified in the baseline schedule to be completed within the Contract Time.
- G. If the latest version of Oracle Primavera P6 or Microsoft Project are not being used, Contractor will submit the qualifications of the scheduling software being proposed as an alternative. Engineer will review the alternative for use on the project.

I.02 CONTENT OF SCHEDULES

- A. The schedule shall be organized by Work Breakdown Structure (WBS)
- B. Each Construction Activity's duration will be no more than four weeks. Level of Effort (LOE) and procurement activities may have durations that are longer.
- C. Specifically identify activities for the following list of structures or items, in addition to other structures or items as necessary.

NOTE: Revise the following list to include appropriate items for each project.

- 1. Site clearing.
 - 2. Site utilities.
 - 3. Foundation work.
 - 4. Structural framing.
 - 5. Material installations.
 - 6. Finishings.
 - 7. Instrumentation.
 - 8. Painting.
 - 9. Training.
 - 10. Testing.
 - 11. Startup.
 - 12. Receipt of spare parts.
 - 13. Pipe installation.
 - 14. Boring and jacking.
 - 15. Restoration.
- D. Include and explain the approach to allow for adverse weather interruptions that are normal for the project location. Normal weather shall mean seasonally average weather conditions, as recorded by NOAA.
 - E. The default calendar used shall be an 8 hour day 5 days a week (40 hour week) including City Holidays. Alternative calendars will be only used after explained and accepted by the Engineer.
 - F. Include plan for all long lead items and materials.

I.03 FORMAT OF SCHEDULES

- A. Prepare CPM schedules in the form of a Time Scale Logic Diagram (TSLD) including the following:

1. Show each activity within each WBS or item.
 2. Include columns of information for:
 - a. Activity ID.
 - b. Activity Description.
 - c. Original Duration.
 - d. Early Start and Finish.
 - e. Late Start and Finish.
 - f. Total Float.
 3. Include a horizontal time scale: At minimum, by year and month from the start of Contract Time.
 4. Use no font smaller than 10 points.
 5. Sheet size: 11 inches x 17 inches., 1 sided, color
- B. TSLD should be sorted by WBS, Item, and Early Start

I.04 SUBMITTAL TYPES DEFINED:

- A. Interim Schedule showing the planned activities for the first 60 days of the project will be submitted and discussed at the Pre-Construction Meeting.
- B. Preliminary Baseline Schedule will be submitted within [14 days] after notice-to-proceed (NTP). The Engineer will review and comment within [2 weeks] for incorporation in Baseline Submittal.
- C. Accepted Baseline (also known as “as-planned”) CPM schedule will incorporate the Engineer review comments and be submitted within [2 weeks] of receipt of those comments.
- D. Once the Baseline Schedule has been submitted and approved, revised monthly progress schedules and updated monthly narrative reports including graphics, reports, and narratives, will be submitted.

I.05 SUBMITTAL REQUIREMENTS

- A. The Narrative Report shall consist of a written report providing an overview of the schedule, specific to each submittal. The Narrative Reports for developmental submittals, e.g. Interim and Preliminary, shall describe the Contractor’s approach to executing the Work. The updated Narrative Reports provided with Monthly Status Reports shall include the items specified in Paragraph I.06.
- B. The Narrative for the Baseline Schedule shall:
 1. Explain key activities and assumptions on which the schedule is based.
 2. Describe the Critical Path.
 3. Discuss key deliveries that might adversely affect the project schedule.
 4. Explain the Contractor’s approach to adverse weather interruptions.

5. Time constraints should be kept to a minimum and the use of any time constraints must be explained why they were used or required.
- C. The following reports are required for Baseline Submittal, with both hardcopy and PDF required to be submitted to the Engineer.
1. [Activity – a report listing all activities, sorted only by Activity ID].
 2. [Early Start – a report listing all activities, sorted only by Early Start date].
 3. [Total Float – a report listing all activities, sorted by Total Float (ascending from low to high)].
 4. [Predecessor/Successor – a report of all activities, sorted by Activity ID that lists the predecessor and successor activities for each activity.]

I.06 PROGRESS REVISIONS

- A. The construction schedule shall be kept up-to-date and the current updated schedule shall be submitted to the Engineer monthly. If the Contractor fails to submit the required updated schedule by the 10th day of the month, the Engineer may withhold a portion of payment until such time as the Contractor submits the required updated schedule.
- B. Include the Physical Percent Complete – the Contractor's estimated physical percent complete for each activity as of the data date for the respective report.
- C. Each month, indicate progress of each activity to data date of submission.
- D. Show changes occurring since previous submission of schedule:
 1. Major changes in scope.
 2. Activities modified since previous submission.
 3. Revised projections of progress and completion.
 4. Other identifiable changes.
- E. Provide an updated Narrative Report with each monthly status report describing:
 1. Any changes to the critical path subsequent to the previous status report
 2. Any changes to the CPM relationships
 3. Loss or gain in the Total Float, with explanation of the main cause of such loss or gain (Variance Report)
 4. Problem areas, anticipated delays, and the impact on the schedule.
 5. Remedial actions or recovery steps that will be employed to arrest and/or recover from delays
 6. Schedule presentation of Look Back over update period and Look Ahead to next 2 update cycles.
 7. Schedule report showing variance to Baseline.
 8. Provide a list of all activities added, deleted, or modified since the last update

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RESPONSIBILITY FOR SCHEDULE COMPLIANCE

- A. The Contractor agrees that whenever it becomes apparent from the current monthly schedule that delays to the critical path have resulted, and hence, that the contract completion date will not be met or when so directed by the Engineer, he will take some or all of the following actions at no additional cost to the City, submitting to the Engineer for approval, a written statement of the steps he intends to take to remove or arrest the delay to the critical path in the approved schedule.
 - 1. Increased construction manpower in such quantities and crafts as will substantially eliminate, in the judgment of the Engineer, any delays to critical path or construction completion.
 - 2. Increase the number of working hours per shift, shifts per working days per week, the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate, in the judgment of the Engineer, any delays to critical path or construction completion.
 - 3. Reschedule activities to achieve maximum practical concurrency of accomplishment of activities, and comply with the revised schedule to eliminate delays to the Critical Path and construction completion date.

3.02 ADJUSTMENT OF CONTRACT SCHEDULE AND COMPLETION TIME

- A. If the Contractor desires to make changes which affect the approved schedule, he shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer takes no exception to these changes, the Contractor shall revise, without additional cost to the City, all of the affected portion of the schedule.
- B. The contract completion time will be adjusted only for causes specified in this contract. In the event the Contractor requests an extension of any contract completion date, he shall furnish such justification and supporting evidence as the Engineer may deem necessary for a determination as to whether the Contractor is entitled to an extension of time under the provisions of this contract. Engineer will, after receipt of such justification and supporting evidence make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to any extension of any contract completion date under the provisions of this contract, the Engineer's determination as to the total number of days extension shall be based upon the currently approved schedule and on all data relevant to the extension. Such data shall be included in the next monthly updating of the schedule. The Contractor acknowledges and agrees that actual delays in activities which, according to the schedule, do not affect any contract completion date shown by the critical path in the schedule do not have any effect on the contract completion date or dates, and therefore, will not be the basis for a change therein.
- C. From time to time, it may be necessary for the contract schedule and/or completion time to be adjusted to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the City or its representatives, and other unforeseeable conditions which may indicate schedule adjustments and/or completion time extension. Under such conditions, the Contractor shall reschedule the work and/or contract completion time to reflect the changed conditions, and shall revise its schedule accordingly. It is specifically pointed out that the use of available float time in the schedule may be used by the City, as well as by the Contractor. Float time is defined as the amount of time between the early start date, and the late start date, or the early finish date and the late

finish date, of any of the activities in the schedule.

- D. Total Float in the approved CPM network is for the mutual benefit of the Project, i.e. either the City or the Contractor may take advantage of available Total Float. Therefore, without obligation to extend either the overall completion date or any intermediate completion dates set out in the schedule, the City may initiate changes to the Work that absorb float time. Contractor-initiated changes that reduce the project total float time identified in the approved schedule may be accomplished with the Engineer's concurrence.

NOTE: Delete the following paragraph unless it is applicable to a specific project.

3.03 COORDINATING SCHEDULES WITH OTHER CONTRACT SCHEDULES

- A. Where work is to be performed under this contract concurrently with and/or contingent upon work performed on the same facilities or area under other contracts, the Contractor's schedule shall be coordinated with the schedules of the other contracts. The Contractor shall obtain the schedules of the other appropriate contracts from the Engineer for the preparation and updating of his schedule and shall make the necessary changes in his schedule when indicated by changes in corresponding schedules.

END OF SECTION

SECTION 4322

PHOTOGRAPHIC DOCUMENTATION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

PART I GENERAL.

I.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to provide photographic documentation of the Project as specified herein.

I.02 SUMMARY.

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final construction photographs.
 - 4. Preconstruction video recordings.

I.03 SUBMITTALS.

Retain "Qualification Data" Paragraph below if Contractor is required to provide professional photographic services.

- A. Qualification Data: For [photographer] [and] [videographer]
- B. Key Plan: Submit key plan of Project site with notation of vantage points marked for location and direction of each [photograph] [video recording]. Include same information as corresponding photographic documentation.
- C. Digital Photographs: Submit image files within [14] days of taking photographs.
 - 1. File Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 2. Submit digital photographs in data disc format acceptable to Engineer.
 - a. Full-size (12-cm / 4.7-inch diameter) CD-R, DVD-R and DVD+R single-use recordable discs are acceptable.
 - b. No other disc types (including but not limited to CD-RW, DVD-RW, or any 8-cm / 3.1-inch diameter Mini CD or DVD) or storage media (including but not limited to USB drives) will be accepted.
 - c. Package each disc in a hard plastic case, clearly and indelibly labeled using self-adhesive labels specifically designed for labeling of discs. Include on the label the project name and the time period covered by the photographs contained on the disc.
 - d. Transmittal of image files by electronic mail is unacceptable.

3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Contractor.
 - d. Date and time photograph was taken.
 - e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - f. Unique sequential identifier keyed to accompanying key plan.

Retain "Construction Photographs" Paragraph below if Contractor is required to submit hardcopy prints of digital photographs in addition to electronic file submittal.

- D. Construction Photographs: Submit [two] prints of each photographic view within [14] days of taking photographs.
 1. Format: 8-by-10-inch smooth-surface matte prints on single-weight, commercial-grade photographic paper; [mounted on linen or card stock to allow a 1-inch- wide margin] and [enclosed back to back in clear plastic sleeves that are] punched for standard three-ring binder.
 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Contractor.
 - d. Date and time photograph was taken.
 - e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - f. Unique sequential identifier keyed to accompanying key plan.
- E. Video Recordings: Submit video recordings within [14] days of recording.
 1. Submit video recordings in digital video disc format acceptable to Engineer.
 - a. Full-size (12-cm / 4.7-inch diameter) CD-R, DVD-R and DVD+R single-use recordable discs are acceptable.
 - b. No other disc types (including but not limited to CD-RW, DVD-RW, or any 8-cm / 3.1-inch diameter Mini CD or DVD) or storage media (including but not limited to USB drives) will be accepted.
 - c. Package each disc in a hard plastic case, clearly and indelibly labeled using self-adhesive labels specifically designed for labeling of discs. Include on the label the project name and the time period covered by the video recordings contained on the disc.

2. Identification: With each submittal, provide the following information:
 - a. Name of Project.
 - b. Name and contact information for videographer.
 - c. Name of Contractor
 - d. Date video recording was recorded.
 - e. Description of vantage point, indicating location, direction (by compass point), elevation or story of construction
 - f. Weather conditions at time of recording.
3. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as corresponding video recording. Include name of Project and date of video recording on each page.

1.04.1 QUALITY ASSURANCE.

Retain "Photographer Qualifications" and/or "Videographer Qualifications" Paragraphs below when project circumstances warrant services of a professional photographer or videographer in lieu of ordinary documentation by Contractor's project staff.

- A. [Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.]
- B. [Videographer Qualifications: An individual who has been regularly engaged as a professional videographer of construction projects for not less than three years.]

PART 2 PRODUCTS.

2.01 PHOTOGRAPHIC MEDIA.

Format in "Digital Photographs" Paragraph below is compatible with all digital cameras. Specify higher image resolution for images that will be enlarged more than 8-1/2" X 11".

- A. Digital Photographs:
 1. Provide digital photographs produced by a dedicated, fixed- or interchangeable-lens digital camera. Images made with cell phones, tablets, webcams, and wearable cameras are not acceptable.
 2. Digital Camera: Have a minimum image resolution of 15 megapixels, and produce images in JPEG (.JPG) format with image dimensions of not less than [3200 by 2400] pixels.
- B. Digital Video Recordings:
 1. Provide video recordings made with a dedicated digital video camera specifically made for video recordings. Video recordings made with cell phones, tablets, webcams, and wearable cameras are not acceptable.
 2. Digital Video Camera: Have a minimum resolution of 720p (1280 x 720, progressive).

3. Provide video recordings in a common digital video format such as .MP4 or .WMV. The minimum resolution of all video files shall be 720p (1280 x 720, progressive). Submit video files on a digital video disc in format acceptable to Engineer.

PART 3 EXECUTION.

3.01 CONSTRUCTION PHOTOGRAPHS.

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs that clearly show the Work. Exhibit correct exposure and focus, accurate color balance, maximum depth of field, minimal optical distortion, and minimal noise. Photographs that, in the Engineer's opinion, do not meet these quality criteria will not be accepted and shall be re-taken at no additional cost to the City.
 1. Maintain key plan with each set of construction photographs that identifies each photographic location.

Insert requirements for other procedures, such as lighting levels and absence or presence of people.

- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 1. Date and Time: Include date and time in file name for each image.
 2. [Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Engineer.]

Retain "Preconstruction Photographs" Paragraph below if required to show preexisting conditions.

- D. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
 1. Flag construction limits before taking preconstruction photographs.
 2. Take [20] photographs to show existing conditions adjacent to property before starting the Work.
 3. Take [20] photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as necessary to record any known or apparent defects existing on the site including settlement or cracking of adjacent structures, pavements, and improvements.

Retain one of first three photographs paragraphs below or replace all with another method where Project requires greater service and the Contract Sum includes costs.

Requirements in "Periodic Construction Photographs" Paragraph below are minimal but adequate for many projects. If needed, add requirement for photographs to be taken of spaces that contain utilities before enclosing finishes are installed.

- E. Periodic Construction Photographs: Take [20] photographs monthly, coinciding] with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

Revise phase descriptions in subparagraphs below to suit Project.

- a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Final Acceptance.
- F. Final Construction Photographs: Take [20] color photographs after date of Final Acceptance for submission as project record documents. Engineer will inform photographer of desired vantage points.

Retain subparagraph below if date stamp is not required.

- I. Do not include date stamp.

3.02 PRECONSTRUCTION VIDEO RECORDINGS.

- A. Videographer: Engage a qualified videographer to record preconstruction video.
- B. Video Recordings:
 - 1. Produce bright, clear, sharp pictures with accurate colors and free from distortion, excessive shake, or any other form of picture imperfection. The audio track of each video recording shall reproduce precise and concise explanatory notes by the camera operator with proper volume, clarity and freedom from distortion and interference. Video recordings that, in the Engineer's opinion, do not meet these quality criteria will not be accepted and shall be re-recorded at no additional cost to the City.
 - 2. Mount camera on tripod before starting recording unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- C. Narration: Describe scenes on video recording by dubbing audio narration off-site after video is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
 - 1. Confirm date and time at beginning and end of recording.
 - 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- D. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.
- E. Preconstruction Video Recording: Before starting construction, record video of Project site and surrounding properties from different vantage points, as directed by Engineer.
 - 1. Flag construction limits before recording preconstruction video.

2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.

END OF SECTION

SECTION 4370

SCHEDULE OF VALUES

PART 1 GENERAL

I.01 REQUIREMENTS INCLUDED.

- A. Submit a Schedule of Values allocated to the various portions of the Work, as specified in Section 4300.
- B. Upon request of the Engineer, support the values with data which will substantiate their correctness.
- C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Pay Estimates.

I.02 FORM AND CONTENT OF SCHEDULE OF VALUES.

- A. Type schedule on an 8-1/2-in by 11-in white paper. Contractor's standard forms and automated printout will be considered for approval by the Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of Project and location.
 - 2. Project number.
 - 3. Name and Address of Contractor.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Schedule shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. For each major line item list sub-values of major products or operations under the item.
- D. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
- E. The sum of all values listed in the schedule shall equal the total Contract Amount.

PART 2 PRODUCTS (NOT USED).

PART 3 EXECUTION (NOT USED).

END OF SECTION

SECTION 4400

QUALITY CONTROL

PART I GENERAL

I.01 SCOPE OF WORK.

- A. This Section includes requirements of a general nature related to the Contractor's responsibility for quality control involving inspections, tests, certifications, and reports. Refer to Section 4410 Testing and Testing Laboratory Services for additional requirements related to quality control.
- B. Unless otherwise indicated in the Specifications, only new materials shall be incorporated in the Work. All materials furnished by the Contractor to be incorporated in the Work shall be subject to the inspection and approval of the Engineer. No material shall be processed for, or delivered to the Site without prior approval by the Engineer.

I.02 INSPECTIONS.

- A. The Engineer shall have the right to inspect all materials at all stages of collection and processing, and shall be allowed access to the site and to the Contractor's and supplier's facilities to conduct such inspections. Onsite work shall be subject to continuous inspection. Inspection by the Engineer shall not release the Contractor from responsibility or liability with respect to material.
- B. When local codes or laws require approval and inspection of the work by other agencies or organizations the Contractor shall obtain such approval and submit one signed original and three copies of the approval to the City.

I.03 QUALITY ASSURANCE – CONTROL OF INSTALLATION.

- A. The Contractor shall monitor quality control over suppliers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. The Contractor shall comply with manufacturers' instructions, including each step in sequence.
- C. The Contractor shall examine the areas and conditions where Work is to be performed and notify the Engineer of conditions detrimental to the proper and timely completion of the Work. The Contractor shall not proceed with the Work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Engineer.
- D. The Contractor shall request clarification from Engineer if manufacturers' instructions conflict with Contract Documents, and shall not proceed with the affected Work before receiving clarification.
- E. The Contractor shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- F. Work shall be performed by persons qualified to produce workmanship of specified quality.

I.04 REFERENCES.

- A. The Contractor shall comply with the reference specifications and standards at a minimum.
- B. For products or workmanship specified by association, trade, or other consensus standards, the Contractor shall comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- C. The Contractor shall be familiar with applicable standards, and shall obtain copies of these standards where required by product specification sections.
- D. The contractual relationship, duties, and responsibilities of the parties in Contract shall not be altered from the Contract Documents by mention or influence otherwise in any reference document.

I.05 INSPECTING AND PHYSICAL TESTING LABORATORY SERVICES.

- A. Laboratory will be provided by the City as specified in Section 4410.

I.06 REPORTS.

- A. The Contractor may, in lieu of the specified tests and at the option of the Engineer, submit for review a Certificate of Compliance in the form of a letter from the manufacturer. The Certificate shall state the following:
 - 1. Manufacturer has performed all required tests.
 - 2. Materials supplied meet all test requirements.
 - 3. Tests were performed within six months of submittal of the Certificate.
 - 4. Materials that were tested are the same type, quality, manufacture, and make as those specified.
 - 5. Include identification of the materials.

PART 2 PRODUCTS (NOT USED).

PART 3 EXECUTION (NOT USED).

END OF SECTION

SECTION 4465

TESTING AND STARTUP

NOTE: Caution must be taken when using this Section. This section can be edited to apply to complete new facilities or to new systems in existing facilities. Specify design or project requirements appropriate for your project.

PART I GENERAL.

I.01 SCOPE OF WORK.

- A. Provide a competent field services technician of the manufacturers of all materials furnished under the technical Specifications to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing and startup of the materials.
- B. Perform specified field performance tests, final acceptance tests and startup services.

I.02 SUBMITTALS.

- A. Submit name, address and resume of proposed field service technicians at least 10 days in advance of the need for such services.
- B. Submit, in accordance with Section, detailed testing procedures for shop tests, field performance tests and final acceptance tests as specified in the various equipment sections. Submittals shall include the following:
 - 1. Test procedures shall be submitted at least 10 days in advance of the proposed test dates and shall include at least the following information:
 - a. Name, classification, model and serial number of equipment to be tested, including reference to specifications by section number and title.
 - b. Schedule of proposed dates and times for testing.
 - c. Summary of needs for power, lighting, chemical, water, sludge, gas, etc., and identification of who will provide them.
 - d. Outline specific assignment of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
 - e. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods, etc).
 - f. Samples of forms to be used to collect and record test data and to present tabulated test results.
 - 2. Copies of test reports upon completion of specified shop, performance and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals and modified to reflect actual conduct of the tests and the following additional information:
 - a. Copy of all test data sheets and results of lab analyses.
 - b. Summary comparison of specified test and performance requirements vs. actual test results.

- c. If actual test results fail to meet specified test and performance requirements, describe action to be taken prior to re-testing the materials.
3. Copies of the manufacturer's field service technician's report summarizing the results of his/her initial inspection, operation, adjustment and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken for proper maintenance, and the material supplier's Certificate of Installation in the format attached to the end of this section.

I.03 QUALITY ASSURANCE.

- A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of the materials and systems being installed.
- B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians unless they can prove their qualifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS.

- A. After installation of the materials has been completed and the materials are presumably ready for operation, and before the materials are operated by others, the manufacturer's field service technician shall inspect, operate, test and adjust the materials. The inspection shall include at least the following points where applicable:
 1. Soundness (without crack or otherwise damaged parts).
 2. Completeness in all details, as specified and required.
 3. Correctness of setting, alignment and relative arrangement of various parts.
 4. Adequacy and correctness of packing, sealing and lubricants.
- B. The operation, testing and adjustment shall be as necessary to prove that the materials have been left in proper condition for satisfactory operation under the conditions specified.
- C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments and tests.

3.02 WITNESS REQUIREMENTS.

- A. Shop tests or factory tests may be witnessed by the Engineer, as required by various specifications.
- B. Field performance and acceptance tests shall be performed in the presence of the Engineer.

3.03 STARTUP OF FACILITIES AND SYSTEMS.

- A. General Requirements.
 1. Successfully execute the step-by-step procedure of startup, normal operation, shutdown, and performance demonstration specified herein.
 2. The startup and performance demonstration shall be successfully executed prior to Final Completion of the facility or system.

3. All performance tests and inspections shall be scheduled with the Engineer at least 10 working days in advance or as otherwise specified. All performance tests and inspections shall be conducted during the work week of Monday through Friday, unless otherwise specified.

B. Preparation for Startup.

1. Upon completion of the facility or system, all channels, basins and tanks shall be cleaned and hydraulically tested for leaks, cracks, and defects in accordance with Section 4480. Potable water facilities and systems shall also be disinfected in accordance with AWWA C653.
2. All mechanical and electrical materials shall be checked to ensure that they are in good working order and properly connected. Preliminary run-ins of the various pumps, compressors, and other remaining materials shall be made. All systems shall be cleaned and purged as necessary. All sumps, tanks, basins, chambers, pump wells and pipelines which are hydraulically checked or tested shall be drained and returned to their original condition once the water testing is complete.
3. All instruments and controls shall be calibrated through their full range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made.
4. Perform all other tasks needed for preparing and conditioning the facility or system for proper operation.
5. No testing or operation shall commence until the Engineer has verified that all specified safety equipment has been installed and is in good working order.
6. No testing or equipment operation shall take place until the Engineer has verified that all lubricants, tools, maintenance materials, spare parts and approved operation and maintenance manuals have been furnished as specified.

C. Facility and System Startup.

1. Startup period shall not begin until all systems and materials have been tested as specified and are ready for operation. The City shall receive spare parts, safety equipment, tools and maintenance materials, lubricants, approved operation and maintenance data and the specified operation and maintenance instruction prior to the startup. All specified valve tagging shall also be complete prior to this startup.

NOTE: Edit the duration to be applicable to your project.

2. Demonstrate a seven consecutive, 24 hour day period of successful operation of the facility or system as a prerequisite of Final Completion.
3. In the event of failure to demonstrate satisfactory performance of the facility on the first or any subsequent attempt, all necessary alterations, adjustments, repairs and replacements shall be made. When the facility is again ready for operation, it shall be brought on line and a new test shall be started. This procedure shall be repeated as often as necessary until the facility has operated continuously to the satisfaction of the Engineer, for the specified duration.
4. The City will furnish all operating personnel (other than vendor's or subcontractor's service personnel) needed to operate the facility or system during the final test period; however, said personnel will perform their duties under Contractor's direct supervision. Until performance tests are completed and units and systems are accepted by the City as complete, the Contractor shall be fully responsible for the operation and maintenance of all new facilities and systems.

NOTE: This paragraph must be customized for each project. Use the listed items only as an example. Select the entity responsible for providing chemicals and electricity.

5. The [City] [Contractor] will provide all necessary chemicals and electricity. However, the Contractor shall provide all necessary personnel of the various construction trades, i.e., electricians, plumbers, etc, and field service personnel of the major equipment suppliers on an 8 hour per day basis at the facilities and on a 24 hour per day basis locally during the startup period. Major suppliers shall include, but not be limited to, the following:
 - a. Instrumentation and Control Materials
 - b. Disinfection Materials
 - c. Chemical Feed and Chemical Storage Systems
 - d. All Pumping Materials
 - e. Boilers and Associated Control Systems
 - f. Generator Materials
 - g. HVAC
 - h. Air Blowers and Compressors
 - i. Sedimentation Basin and Clarification Materials
 - j. Intake Screens or other screening devices
 - k. Grit Removal Systems
 - l. Filtration Materials
 - m. Mixing Materials
 - n. Dewatering/Thickening Materials
 - o. Conveyance Systems
6. Do not, at any time, allow the facility or system to be operated in a manner which subjects materials to conditions that are more severe than the maximum allowable operating conditions for which the materials were designed.

MATERIAL SUPPLIER'S CERTIFICATE OF INSTALLATION

Owner - CITY OF SHREVEPORT

Project _____

Contract No. _____

MATERIAL SPECIFICATION SECTION _____

MATERIAL DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

Manufacturer's _____

hereby CERTIFY that _____
(Print material name and model with serial no.)

installed for the subject project has (have) been installed in a satisfactory manner, has (have) been tested and adjusted, and is (are) ready for final acceptance testing and operation on:

Date _____

Time _____

CERTIFIED BY: _____
(Signature of Manufacturer's Representative)

Date: _____

END OF SECTION

SECTION 4480

TIGHTNESS TESTING OF CONCRETE STRUCTURES

NOTE: Insert or select all information indicated by square brackets, including in the Header and Footer, then delete brackets around the item.

NOTE: Tests are an objective way to demonstrate performance. When the completed structure is judged against an applicable industry standard, the City's position is defensible.

PART I GENERAL.

I.01 SCOPE OF WORK.

- A. Furnish all labor, materials, equipment and incidentals required and perform tightness testing of liquid-retaining concrete structures listed herein and all retesting until the structures meet the requirements specified herein. Refer to Section _____ for tightness testing of concrete manholes.

I.02 SUBMITTALS.

- A. Submit for each structure a detailed plan and schedule which shows the method of filling and disposal of water.
- B. Submit for each structure a completed Tightness Test Report (Figure A, appended at the end of this Section) of each test for each structure.

I.03 REFERENCE STANDARDS.

- A. American Concrete Institute (ACI).
 - 1. ACI 350.1-01 - Tightness Testing of Environmental Engineering Concrete Structures and Commentary.

I.04 PROJECT/SITE REQUIREMENTS.

- A. Coordinate timing and procedures for obtaining water for testing, structure testing, and water disposal with the Engineer a minimum of 30 days in advance of the actual testing.
- B. Water Source and Disposal.

NOTE: Provide statements similar to the following examples. Coordinate specific project requirements with the Process Engineers. The quality of proposed testing water, e.g. pH and brine content, must be evaluated.

- 1. [Water for testing shall be provided by the Contractor.]
- 2. [Water for testing shall be plant process water. Water shall be obtained at a time, rate of flow and location approved by the City. All labor, materials, equipment, incidentals and power required to convey the water to the structure shall be provided by the Contractor.]
- 3. [Water for testing may be taken from the plant water system. Contractor shall make arrangements with the Engineer to obtain such water. All labor, materials, equipment, incidentals and power required to convey the water to the structure shall be provided by the Contractor.]

NOTE: Provide statements similar to the following examples. Recognize that chlorinated water may need dechlorination before disposal in certain locations. Coordinate specific project requirements with the Process Engineers.

4. [Test water shall be disposed of by the Contractor in an approved manner. Water shall not be disposed of by discharging it onto the ground surface of public or private land.]
5. [Test water shall be disposed of by reintroduction into the Plant process at the time, rate of flow and location approved by the City.]

PART 2 PRODUCTS (NOT USED).

PART 3 EXECUTION.

3.01 GENERAL.

- A. The tightness testing of liquid retaining concrete structures shall conform to ACI 350.1-01 and as specified herein.

NOTE: Delete if tanks are all above ground. For each structure to be tested, consider how the structure layout, site layout, and construction sequencing can influence the ability to conduct the test. For instance, a simple example of structure layout and construction sequencing is an effluent trough that has an invert elevation lower than the tank invert elevation. The tank cannot be completed without backfilling against the walls of the trough. The trough cannot be observed during the tightness test and may be a source of unidentified leakage (as may be the base mat of the tank). For instance, a simple example of structure layout, site layout, and construction sequencing would be an effluent channel with an invert elevation higher than the tank invert. The channel cannot be completed until that wall of the tank is backfilled, and if the channel extends away from the tank, that part of the channel also cannot be completed until backfill is placed. Some cases may need added paragraph(s) below for each project specific case, and others may not, but in all cases the consideration of structure layout, site layout, and construction sequencing will prepare the project team for questions the Contractor will raise during construction. Modify if construction sequencing requires backfilling prior to tightness testing, such as multi-level below grade tanks.

NOTE: Contractor requests to backfill prior to testing shall include a description of the method proposed to detect leakage points after the backfill is in place and how repairs will be made. Approval to place backfill prior to testing shall not relieve the Contractor of the responsibility for conducting tightness tests.

- B. Perform tightness tests prior to waterproofing and dampproofing and prior to placing backfill around the structure in order to permit observation and detection of leakage points.

NOTE: If multi-cell tanks are included, identify the following testing requirements. If minor seepage can be tolerated into a dewatered cell, consider testing all cells as a unit, to reduce testing costs.

- C. [Each cell of multi-cell tanks shall be tested individually, unless otherwise noted.]
- D. [Multi-cell tanks may be tested as a single unit where noted.]

3.02 PREPARATION.

- A. Remove all dirt, mud and debris from the structure prior to initiating tightness tests. The floor and sumps shall be flushed with water to provide a clean surface, ready for testing.
- B. Inlet and outlet pipes not required to be operational for the tests shall be temporarily sealed or bulkheaded prior to testing.
- C. Confirm that all openings including pipes, valves, gates, access doors, etc. are completely closed, and watertight. Repair and reset seals if necessary. Estimates of leakage through openings will not be allowed as adjustments to the measured structure leakage.

3.03 EXAMINATION.

- A. Inspect the structure to be tested for potential leakage paths including cracks, voids, honeycombs and unsealed joints; and repair such paths as directed by the Engineer, at no additional cost to the Owner.

NOTE: The following applies to cast in place reinforced concrete tanks.

3.04 TESTING PROCEDURES.

NOTE: Edit as necessary.

NOTE: The intent is to test the completed structure. Testing of a partially completed structure is not a representative test. It may not be possible to apply the full head of pressure and the structural response (movements, deflections, crack widths) will be less than if the full load is applied. Also, flow through defects will be less than what would occur if the structure was filled to the operating level. Furthermore, the structural system of a partially completed structure may be entirely different than that of the completed structure and respond in an entirely different manner, or be unsafe (for instance, testing before a roof slab is in place when the roof slab is used to provide horizontal support at the top of the walls). Testing of a partially completed structure may damage it.

- A. Conditions of Testing.
 - 1. Do not begin filling of reinforced concrete structure until all concrete elements of the structure have attained the specified design strength, but not less than 28 days after all concrete elements have been placed, or after the structure has attained the specified design strength.
 - 2. Filling of reinforced concrete structure shall not exceed a rate of 4-ft in 24 hours.
 - 3. Fill reinforced concrete structure to the maximum operating water surface level and maintain the water at that level for at least 72 hours prior to beginning tightness tests to minimize water absorption by the concrete during testing.
 - 4. Test only a single structure at a time. Concurrent testing of contiguous or adjacent structures will not be allowed. For the purpose of tightness testing a single structure is any tank, wet well, basin, cell, compartment, filter, channel or similar construction which may be isolated such that it may be full of liquid when adjacent construction is empty.
- B. Testing Procedures.
 - 1. Duration of the test shall not be less than the time required to produce a drop in the water surface of 1/2-in based on the calculated maximum allowable leakage rate or 3 days, whichever is greater.

2. Measure water surface elevations at 24 hour intervals. Record water temperature 18-in below the water surface when taking the first and last sets of measurements. The methods used to determine the amount of precipitation or evaporation shall be approved by the Engineer.
3. The percentage of water volume loss shall be computed based on the measured change in water surface elevation, the area of the horizontal water surface, the initial water volume and any correction for precipitation or evaporation where applicable.

NOTE: When existing structures are extended horizontally or vertically or otherwise modified there may be some value in testing the interface with the existing structure and the new construction. It is probably not reasonable to expect the existing construction to satisfy the criteria for new structures and is also not reasonable to make the Contractor responsible for existing defects and leaks. Still, in these cases there may be some value in conducting only the visual aspects of the tightness test, especially in the vicinity of the interface. The following text may be used as a guide in these situations.

- C. [The Existing Primary Clarifiers No. 1-3 and Existing Primary Clarifiers Effluent Channel shall be tested by observation only for the conditions listed in Paragraph 3.05 A.]
- D. Reports.
 1. Notify the Engineer of the scheduling of tests 10 working days prior to the tests. The Engineer may monitor any tightness testing performed on the structures.
 2. Submit a completed Tightness Test Report on Form an appended to this Section for each structure tested.

3.05 ACCEPTANCE.

- A. The following conditions shall be considered as NOT meeting the criteria for acceptance regardless of the actual loss of water volume from the structure.
 1. Groundwater seeping or flowing into the structure through floors, walls, or wall-floor joints.
 2. Structures which exhibit seeping or flowing water from joints, cracks, voids, honeycombs, or from beneath the foundation.
 3. [Increased flow from underdrain system during tightness testing.]
 4. Damp spots on concrete surfaces.
 5. [Moisture deposited on a dry hand held against the exterior surface of the structure.]

NOTE: These acceptable losses apply to cast in place reinforced concrete tanks. Edit as required.

- B. The tightness of concrete tanks and structures shall be considered acceptable when the conditions of Paragraph 3.05 A are not present and when loss of water volume is within the criteria listed below:
 1. [For unlined (or partially lined) reinforced concrete tanks, loss of volume not exceeding.
0.10 percent in 24 hours (HST-100).]
 2. [For reinforced concrete tanks with fully lined walls, loss of volume not exceeding 0.05 percent in 24 hours (HST-050).]

3. [For completely lined tanks, no measurable loss of volume (HST-NML).]

3.06 REPAIRS AND RETESTING.

- A. Structures failing the tightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Structures failing this second test shall be repaired at no additional cost to the City prior to further testing.
- B. Repaired structures shall be retested. Repairs and retesting shall be conducted at no additional cost to the City and shall be continued and repeated until the structure meets all requirements specified herein.

3.07 SCHEDULE.

- A. The following structures shall be tested for tightness:

NOTE: List as necessary. Use specific names or tank numbers where possible. Tightness testing may not be required for all liquid retaining structures.

- 1.
- 2.
- 3.
- 4.

END OF SECTION

FIGURE A TIGHTNESS TEST REPORT

PROJECT _____ SUBMITTED BY _____
STRUCTURE* _____ TEST DATES _____

Allowable loss of water volume _____ percent in 24 hrs.
Measured loss of water volume _____ percent in 24 hrs. (From D below)

TEST READINGS

Water temperature at start _____ degrees F
Water temperature at end _____ degrees F

Water Surface Elevation

	Date	Time	Location 1	Location 2	Location 3	Location 4	Initials
1.	_____	_____	_____	_____	_____	_____	_____
2.	_____	_____	_____	_____	_____	_____	_____
3.	_____	_____	_____	_____	_____	_____	_____
4.	_____	_____	_____	_____	_____	_____	_____
5.	_____	_____	_____	_____	_____	_____	_____
Change in level			_____	_____	_____	_____	_____
A	Average change in level			_____			
.							
B	Correction for precipitation/evaporation			_____			
.							
C	Corrected change in level = CL =			_____			
.							

D	Measured percent water loss in 24 hrs.	=	(CL) x (surface area) x (100)
.			(initial water volume) (number of test days)

Notes and field observations**

* Attach a sketch showing a plan of the structure and measurement locations. ** Place date and initials at the beginning of each entry.

NOTE: Add to or delete from these requirements to suit the anticipated staff size and project requirements. Also verify model nos. where required.

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4500

TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, equipment, materials, and incidentals necessary and provide separate temporary facilities for the Contractor's use and the Engineer's use, as specified herein and as shown in the contract documents.
- B. Operate and maintain temporary facilities for the duration of the project and as directed by the Engineer. All cost and use charges for temporary facilities shall be included in the Contract Amount.

1.02 SUBMITTALS

- A. Submit shop drawings and product data, in accordance with Section 4300, showing materials of construction and details of installation for:
 - 1. Engineer's Field Office: Dimensioned floor plan, office systems, furnishings, and equipment.
 - 2. Temporary Fence: Layout drawings which indicate dimensions, access to fire hydrants, gate locations and opening sizes, and other site specific requirements.
 - 3. Contractor Sign: Layout, graphics, and wording.

1.03 QUALITY ASSURANCE

- A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.
- B. Coordinate with authorities having jurisdiction to inspect (and test if required) temporary facilities.
- C. Obtain all required permits for temporary facilities.

PART 2 PRODUCTS

2.01 MATERIALS

NOTE: Select the portion in brackets if temporary fence will not be measured for direct payment.

- A. Temporary Fence: As specified in Standard Specification Section 803 Chain Link Fence [except that it will not be measured for direct payment].

2.02 ENGINEER'S FIELD OFFICE

NOTE: Confirm size and features of office trailer needed.

- A. Provide minimum [12 ft X 50 ft] office trailer for the Engineer's exclusive use for the duration of the project. Field office trailer shall have at least one office, one conference room, one bathroom, and two exterior doors.
- B. The bathroom shall include a toilet, sink and faucet, medicine cabinet, and exhaust fan.
- C. The conference room shall include a built-in plan table.
- D. The Engineer's field office shall be weather-tight construction with floor, walls, and ceiling completely insulated. Each room shall have at least one operating window. Each window shall have a venetian blind and full insect screen. Furnish two sets of keys for each exterior door. Provide fully insulated skirting on all sides of the field office trailer. Provide steps, platforms, handrails, and boot scrapers for each exterior door.
- E. Field office trailer shall be Mobile Mini, ModSpace, Williams Scotsman, or equal. Converted storage or box containers will not be acceptable.
- F. Furnishings
 - I. Provide the following furnishings for the Engineer's temporary field office for the duration of the project. All furnishings shall be new – or in very good condition – subject to approval of the Engineer.

NOTE: Confirm number.

- a. [Three] 60-in by 30-in desks with file drawer and 5 drawers, all lockable. New upholstered swivel type chair with arms for each desk.

NOTE: Confirm size and number.

- b. [One] [30-in by 84-in] conference table

NOTE: Confirm number.

- c. [Eight] armless side chairs (stacking type)

NOTE: Confirm size and number.

- d. [Two] [54-in by 30-in] folding tables

NOTE: Confirm size and number.

- e. [Six] file cabinet, 4 drawer, [legal size], Hon No. HN-315C, or equal

NOTE: Confirm number.

- f. [Four] wastebaskets

NOTE: Confirm size and number.

- g. [One] rolling plan storage rack, , [24"] [30"] 10-stick capacity

NOTE: Confirm size and number.

- h. [One] lockable storage cabinet, [72-in high, 36-in wide, and 18-in deep]

NOTE: Confirm number.

- i. [Two] steel bookcase units, 4 shelves high, Hon No. HN-S48 ABC, or equal

- j. One digital telephone answering machine

NOTE: Confirm number.

- k. [24] painted steel coat hangers
- l. Fire Extinguishers: Provide portable, UL-rated with class and extinguishing agent required by locations and classes of fire exposure. Provide at least one for each trailer/office.
- m. Two smoke detectors, with batteries

NOTE: Confirm size.

- n. One wall-mounted first aid kit, McMaster-Carr 9501T1 or equal, OSHA (1910.151.b) and ANSI (Z308.1-2003) compliant, [suitable for ten people].

NOTE: Confirm number.

- o. [Two] dry erase boards, aluminum frame, 36-in by 60-in, markers and eraser, Quartet Model No. TS-S 535 or equal

NOTE: Optional for large projects.

- p. One 1000-watt minimum 1.4-cuft microwave oven

NOTE: Optional for large projects

- q. One 6-cf refrigerator

NOTE: Optional for large projects

- r. One 4-cup or 12-cup coffeemaker with timer, by Krups, or equal.

NOTE: Optional for large projects

- s. Commercial duty cross-cut shredder with basket, designed for 3 to 5 users, Fellowes Powershred SB-125i, or equal

G. Office Equipment

- l. Provide the following equipment for the Engineer's temporary field office for the duration of the project. All equipment shall be new.

NOTE: On larger projects, 11x17 inch printing capability may be needed

- a. A multifunction photocopier, printer, facsimile and scanner with 50-sheet auto-feeder, capable of copying and printing letter-sized, legal-sized [and 11x17-inch] documents. Provide paper and ink cartridges, as required, for the duration of the project.

NOTE: Confirm; edit as needed.

- b. Four 8-outlet surge protectors with six foot cord and minimum 1800-joule energy rating or greater; as manufactured by Belkin, or equal.

H. Services

1. Provide the following services for the duration of the project. Services shall include all costs for installation, use, maintenance, and removal of all products, services and equipment billed by each provider for each service specified herein.
2. Field office shall have complete and fully functional electrical, plumbing, and HVAC systems. Perform all scheduled and unscheduled maintenance for all systems and as directed by the Engineer.
3. Electrical System: Provide connection to temporary electric service. Comply with the electrical requirements of the furnished office trailer. Provide main circuit panel, sufficient GFCI outlets and lighting in each room, exterior lights at each exterior door, and proper grounding of entire electrical system.
4. Plumbing system: Connect to existing potable water supply. Provide water heater and hot and cold water to each fixture. Connect waste pipes to existing sanitary system or a waste holding tank. Heat trace and insulate exterior piping to prevent freezing.
5. HVAC System: Provide central heating and air conditioning system with programmable thermostat. System shall be capable of maintaining an interior temperature of 70°F when the exterior temperature is 0°F and an interior temperature of 75°F when the exterior temperature is 100°F.
6. Bottled water service: Provide bottled water service complete with dispenser with hot and cold water taps and regular bottle and cup replenishment as directed by the Engineer.
7. Janitorial service: Provide janitorial services (at least weekly) that include dusting, sweeping, vacuuming, mopping, disinfection, and trash removal.
8. Sanitary service: Provide regular pumping of waste holding tank, if applicable, as needed.

NOTE: Add to or delete from the following as required to suit the anticipated staff size and project requirements.

9. Communications

- a. Install two telephone lines in the Engineer's field office for the Engineer's exclusive use:
 - i. one voice grade line with caller ID and call-waiting features
 - ii. a second line for a dedicated fax line.

10. Internet Access

- a. Provide a high-speed cable line with internet access for the duration of the project.
11. Pay all costs for installation, maintenance, and removal of the telephone and internet service and instruments. The monthly cost of all calls made and received by the Engineer, including toll and long distance calls, shall be paid for by the Contractor for the duration of the project.
- I. Office Supplies: Provide the following supplies for the duration of the project: copy paper, toner, toilet paper, paper towels, soap, light bulbs, and other consumables as required by the Engineer.

PART 3 EXECUTION

3.01 ENGINEER'S OFFICE

- A. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed and prior to commencement of Work at the site. All systems, furnishings, equipment, and services specified herein shall be furnished, installed, and completely operational for the field office to be considered established.
 - 1. Provide regular office cleaning services for the duration of the project.
 - 2. Provide supplies including, but not limited to restroom supplies (toilet tissue paper, paper towel, and soap), as well as light bulbs, air conditioner filters, etc.
 - 3. Provide office supplies for printers and fax machines, etc.
 - 4. Supply all fuel for heating and pay all utility bills.
- B. Install field office plumb and level.
- C. Engineer's trailer shall be removed and the site shall be cleaned up and restored before Final Completion.

3.02 CONTRACTOR'S FIELD OFFICE

- A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractor's field office from the Engineer shall be considered delivered to the Contractor.
- B. Locate field office(s) in accordance with approved shop drawings and as directed by the City.
- C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or the City.

3.03 TEMPORARY POWER AND LIGHT

- A. Furnish temporary light and power, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.

NOTE: Use the following two Paragraphs when power is available from existing facilities.

NOTE: Confirm who will be responsible for electrical consumption for the duration of the project.

- B. Provide connections to existing facilities sized to provide service required for power and lighting. [Contractor shall pay the costs of power used.] [City will provide available power at no cost to Contractor.]
- C. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.

- D. Provide grounded extension cords. Use heavy duty cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.
- E. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

3.04 TEMPORARY HEAT

- A. Provide heat as may be necessary for heating materials and for proper execution, protection and drying-out of the Work.

3.05 TEMPORARY AIR AND WATER

- A. Provide all air and water, including temporary piping and appurtenances required for cleaning and testing pipelines and equipment. Remove temporary piping and appurtenances upon approval of equipment being tested.

3.06 SANITARY FACILITIES

- A. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved nonabsorbent shell.

3.08 CONSTRUCTION AIDS

- A. Provide temporary elevators, hoists, cranes, scaffolding and platforms as necessary to perform the Work. Provide temporary stairs where ladders are not adequate. Protect permanent stairs from damage from construction operations.

3.09 VEHICLE ACCESS AND PARKING

- A. Provide temporary access roads, parking areas, traffic control devices and staging areas as approved by the Engineer.
- B. Provide minimum 12-ft by 24-ft by 6-in deep dense graded crushed stone or paved parking area adjacent to Engineer's field office for exclusive use by the Engineer for the duration of the project.

3.10 TEMPORARY FENCE

- A. Provide temporary fence as shown on the Drawings, as specified herein, and as the Contractor requires for site security.
 - 1. Provide 6-ft high chain link fence with at least two vehicle and two pedestrian access gates. Gates shall be equipped with locking hardware and padlocks. Furnish two sets of keys to Engineer and the City. Coordinate with local first responders for access during non-work hours.
 - 2. Fence installation shall comply with requirements of Standard Specification Section 803.
 - 3. Perform daily inspections of fence and immediately repair or replace damaged or compromised sections and as directed by the Engineer.

3.11 WASTE MANAGEMENT

- A. Provide covered dumpster, minimum 4-cubic yards, dedicated for field office waste. Provide separate covered dumpster of adequate size for construction debris. Empty dumpsters on a regular basis and as directed by the Engineer. Dumpsters shall not exceed their capacities at any time.

3.12 PROJECT IDENTIFICATION SIGNS

- A. Provide, install, and maintain signs as specified in Technical Specification Section 4580 Project Identification Signs.
- B. Remove signs at Final Completion.

3.13 REMOVAL AND RESTORATION

- A. Remove each temporary facility complete when need for its service has ended and as approved by the Engineer. Coordinate removal of temporary facilities with authorities having jurisdiction.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4562

DUST CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Perform dust control operations, in an approved manner, whenever necessary or when directed by the City, even though other work on the project may be suspended.
- B. Dust control shall be generally accomplished by cleaning, sweeping, and sprinkling with water. The use of water resulting in mud will not be permitted as a substitute for sweeping or other methods. Calcium chloride may be used when necessary to control dust nuisance.
- C. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.

2.02 SWEEPING EQUIPMENT

- A. When identified in the contract documents, furnish[Furnish and operate] a self-loading motor sweeper with spray nozzles at least once each working day to keep paved areas acceptably clean wherever construction, including restoration, is incomplete.

PART 3 EXECUTION

3.01 MAINTENANCE

- A. Abate dust nuisance throughout all phases of construction until final acceptance of the Project.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4580

PROJECT IDENTIFICATION SIGNS

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Provide and maintain a Contractor Sign.

1.02 SUBMITTALS

- A. Submit details of Contractor Sign in accordance with the requirements of Section 4300. Show content, layout, lettering style, lettering size, and colors. Make sign lettering to scale, clearly indicating condensed lettering if used.

1.03 CONTRACTOR SIGN

NOTE: Specify more than one sign for linear projects or projects with work in multiple locations. Identify approximate locations of signs on the drawings.

- A. Provide [1] sign(s) at location(s) shown on the Drawings unless otherwise directed by the Engineer.
 - 1. Provide one sign at each end of linear project involving paving or pipeline construction in rights-of way.
 - 2. Provide one sign for site or facility construction projects.
 - 3. Provide one sign at each site for projects with multiple sites.
- B. Construct signs with new materials in accordance with details shown on the Drawings. Maintain signs to present a clean and neat appearance throughout the Project duration.
- C. Signs shall be painted and lettered by an experienced professional in the type of work required.
- D. Payment for furnishing and maintaining Contractor Sign(s) will be considered incidental to the cost of the Project (no direct payment). If the Contractor fails to properly install or maintain the sign(s), a penalty of \$100 per day per sign will be assessed, and the sum of penalties will be deducted from any payments due the Contractor

PART 2 PRODUCTS

2.01 CONTRACTOR SIGN MATERIALS

- A. Sign Posts: 4"X 4" pressure treated wood posts, 12 feet long (minimum) for in-ground mounting.
- B. Fasteners shall be galvanized steel. Attach sign to posts with 1/2"X 5-1/2" button head carriage bolts and secure with nuts and washers. Cover button heads with reflective film or coating to match the sign background.

- C. Sign: 4'X 8' X $\frac{3}{4}$ " exterior B-C plywood. Do not piece plywood sheets to fabricate a sign face.
- D. Coating: White industrial grade, fast-drying, oil-based paint with gloss sheen for posts and sign. Paint both sides and all edges of sign prior to adding adhesive applications.
- E. Sign Background: Reflective white 3M Scotchlite Engineer Grade, Pressure Sensitive Sheeting (White) or equal
- F. Lettering: 3M Scotchcal Pressure Sensitive Films (Black), or equal, for lettering.
- G. City will furnish an electronic City Seal for use by the Contractor.

2.02 CONTRACTOR SIGN LAYOUT

- A. Lettering Style, Size, and Spacing: Helvetica Regular.
- B. Condensed style text may be utilized if necessary to maintain sign composition.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install Contractor Sign(s) prior to mobilization, at locations shown on the Drawings unless otherwise directed by the Engineer. Position each sign so it is fully visible and readable to the general public.
- B. Install signs level and plumb. Sink posts 3 feet to 4 feet below grade and stabilize posts to minimize lateral motion. Leave a minimum of 8 feet of post above grade for mounting sign.

3.02 MAINTENANCE AND REMOVAL

- A. Maintain signs and supports in a neat, clean condition; repair deterioration and damages to structure, framing and sign.
- B. Remove signs, framing, supports, and foundations to a depth of at least 2 feet below grade upon completion of the Project. Restore area to a condition better than or equal to the existing condition prior to construction.

END OF SECTION

NOTE: The term “materials” can include “equipment” in the conventional usage of that term. In the General Provisions, however, the term “equipment” is defined differently, so the term “materials” is always instead of “equipment”. Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4600

DELIVERY, STORAGE AND HANDLING

PART I GENERAL

I.01 SCOPE OF WORK

- A. This Section specifies the general requirements for the delivery, handling, storage and protection for all items required in the construction of the Work. Specific requirements, if any, are specified with the related item.

I.02 TRANSPORTATION AND DELIVERY

- A. Transport and handle items in accordance with manufacturer's instructions.

NOTE: Consider manufacturing and delivery time for various items and insert a reasonable maximum duration of storage at the site.

- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall materials be delivered to the site more than [] months prior to installation without written authorization from the Engineer.
- C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
- D. Deliver products to the Site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
- E. All items delivered to the Site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
- F. Provide necessary equipment and personnel to unload all items delivered to the Site.
- G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e., City, other Contractors), perform inspection in the presence of the Engineer. Notify Engineer verbally, and in writing, of any problems.
- H. If any item has been damaged, such damage shall be repaired at no additional cost to the City.

I.03 STORAGE AND PROTECTION

- A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Engineer. Carefully follow storage instructions and maintain written documentation of compliance. Arrange storage to permit access for inspection.
- B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

- C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. If, in the opinion of the Engineer, there is excessive rust formed on reinforcing steel, it shall not be used. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.
- D. All mechanical and electrical materials subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.
 - 1. All materials shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.
 - 2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the materials, the Contractor shall start the materials, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
 - 3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
 - 4. Prior to acceptance of the materials, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.
- E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION

NOTE: This section is used when the contract documents include a requirement for engineering design of a structure subject to a seismic load. Some potentially applicable structures are included as examples. This section should be edited by a structural engineer. Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4612

SEISMIC DESIGN REQUIREMENTS

PART I GENERAL

I.01 DESCRIPTION

- A. Provide seismic restraint of nonstructural components to withstand seismic demands without displacing or overturning.
- B. Provide non-building structures designed and constructed to withstand seismic demands as specified herein.
- C. For designated seismic systems, provide installations capable of providing post-earthquake functionality.

I.02 SCOPE OF WORK

- A. Architectural, mechanical, electrical and plumbing components and systems and non-building structures shall be designed and constructed for seismic demands unless specifically exempted in ASCE 7.
- B. Design, furnish and install complete seismic restraint systems.
- C. Provide equipment/product certifications to be submitted for review by the Engineer. The following systems and components specifically require certification:

I.03 SUBMITTALS

- A. Submit, in accordance with Section 4300, Shop Drawings and Product Data including the following:
 - 1. Shop Drawings:
 - a. Seismic restraint Shop Drawings shall be prepared, sealed and signed by a Professional Engineer. Shop Drawings shall indicate all restraint details including materials, quantities, anchor bolts, size and embedment of anchor bolts, base plate setting details and locations, and location, direction and magnitudes of all loads transferred to the structure.
 - b. Include sufficient information regarding the component attachments to verify compliance with applicable codes and standards.
 - c. [The use of proprietary restraint systems with a Certificate of Compliance verified and listed by an IAS accredited Inspection Agency is acceptable.]
 - 2. Seismic Calculations:
 - a. Seismic calculations shall be prepared, sealed and signed by a Civil or Structural Professional Engineer and submitted with the Shop Drawings.

- b. Include sufficient information regarding the component attachments to verify a continuous load path of sufficient strength and stiffness that demonstrates compliance with applicable codes and standards.
- 3. Special Seismic Certification of Designated Mechanical Equipment, Electrical Equipment and Distribution Systems:
 - a. Each manufacturer of designated seismic system shall submit a Certificate of Compliance indicating that the component and its mounting system and anchorage have been tested or analyzed to withstand required seismic demands and maintain operability following the design Building Code earthquake. Provide qualification based on shake table testing or by engineering analysis as specified below.
 - b. Shake Table Testing
 - i. Qualification shall be by an actual test on a shake table with three-dimensional shock tests, an analytical method using dynamic characteristics and forces and/or experience data based upon nationally recognized procedures acceptable to the Authority Having Jurisdiction and Engineer.
 - ii. Certificate must be verified by an IAS accredited Inspection Agency or other independent inspection entity acceptable to the Authority Having Jurisdiction and Engineer.
 - iii. Components shall be labeled with an identification applied on the product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of the accredited Inspection Agency that indicates that the representative sample of the product or material and its testing have been evaluated and listed by the accredited Inspection Agency.
 - c. Engineering Analysis
 - i. If a particular component has not been evaluated by shake table testing and listed by an accredited Inspection Agency, then qualification must be by analysis performed by a Professional Engineer. Analysis must include an evaluation of stress and deformation developed through the entire load path from the center of applied seismic load to the equipment anchorage. Analysis must consider dynamic characteristics and the response spectrum required by the Building Code.
 - ii. Special Seismic Certification for distribution systems such as piping and ductwork shall include a stress analysis of the pipe/duct, supports, bracing and anchors. The stress analysis shall include gravity and seismic demands and shall include an analytical assessment of connections and consideration of movement of points of attachment. The effects of in-line devices, where present, shall be considered in the analysis. Conformances with NFPA 13 will satisfy Special Seismic Certification requirements for fire protection piping.
 - d. Submit Certification of Engineer Qualifications for Special Seismic Certification. Provide certification and experience documentation for the Professional Engineer indicating a minimum of 5 years of experience providing engineering services of the kind indicated when analysis or shake table testing is the justification for the certification for each designated seismic system.

I.04 DEFINITIONS

- A. Anchorage: Connection to structure typically through the use of welding, bolts, screws, anchor bolts, post-installed anchors or other fasteners selected to meet the Building Code.
- B. AHJ: Authority Having Jurisdiction – The governmental agency or subagency that regulates the construction process. This may be a local building department, state agency, federal entity or other body or bodies having statutory authority.
- C. Code or Building Code: Building Code currently in effect where the Project is located.
- D. Designated Seismic System: Those architectural, electrical and mechanical systems and their components that require seismic design or qualification in accordance with ASCE 7 and for which the component importance factor, I_p , is 1.5 according to ASCE 7.
- E. IAS: International Accreditation Service, Inc.
- F. IBC: International Building Code
- G. ICC-ES: International Code Council Evaluation Service
- H. Inspection Agency: Organization or individual accredited to ISO 17020 and regularly engaged in factory inspection services for seismic restraint or qualification of non-structural components and equipment.
- I. Professional Engineer: A Professional Engineer is one who is registered and legally qualified to practice in Louisiana, and who is experienced in providing engineering services of the kind indicated. For work associated with designated seismic systems, Professional Engineer must have a minimum of 5 years of experience providing engineering services of the kind indicated and be approved by the Engineer.
- J. Nonstructural Component: A part or element of an architectural, electrical or mechanical system permanently attached to a structure including its supports and attachments.
- K. Restraint/Bracing: Bracing or anchorage used to limit movement under seismic forces. Cables or rigid elements (strut, pipe, angles, etc.) used to resist forces by uniaxial tension or compression. The term "bracing" may also be used to describe design to resist lateral forces through the use of wall or frame elements.
- L. Seismic Deformations: Drifts, deflections and relative displacements determined in accordance with the applicable seismic requirements of the Building Code.
- M. Seismic Demand: Forces and deformations caused by a Code seismic event that must be resisted or accommodated by a structure, component, or system.
- N. Seismic Forces: Forces acting in any direction due to the action of an earthquake as defined in the Building Code.
- O. Special Inspector: An IAS accredited IBC Special Inspection Agency or qualified Professional Engineer who demonstrates competence, to the satisfaction of the building official (or Authority Having Jurisdiction [AHJ]), for inspection of the designated seismic systems. The City shall employ one or more Special Inspectors to provide periodic inspections during installation of designated seismic systems.
- P. Support: Elements used to support the weight (gravity load) of an item. Where the support is located at a seismic brace, the element may also resist tension/compression reactions from the restraint system.

Q. VISCMA: Vibration Isolation and Seismic Control Manufacturers Association

I.05

REFERENCE STANDARDS

- A. American Concrete Institute (ACI):
 - 1. ACI 355.2 – Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary
 - 2. ACI 318 – Building Code Requirements for Structural Concrete including Appendix D – Anchoring to Concrete (2008)
- B. American Society of Civil Engineers (ASCE)
 - 1. ASCE 7 – Minimum Design Loads for Building and Other Structures (2005)
- C. ASTM International
 - 1. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete Elements
- D. International Code Council, Inc. (ICC):
 - 1. International Building Code (IBC) – 2006 Edition
- E. International Organization for Standardization (ISO)
 - 1. ISO/IEC 17020 – General Criteria for the Operation of Various Types of Bodies Performing Inspection
- F. National Fire Protection Association (NFPA)
 - 1. NFPA 13 – Installation of Sprinkler Systems (2010)
- G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply, unless otherwise noted.

I.06

QUALITY ASSURANCE

- A. Comply with the International Building Code (IBC) latest adopted Edition by the jurisdiction where the Project is located and applicable local and/or statewide adopted amendments.
- B. Special Seismic Certification – Provide certification in accordance with IBC, Chapter 17 and ASCE 7 Chapter 13 and 15 requirements for designated seismic systems.
- C. Provide a quality assurance plan as required by ASCE 7, Appendix 11A for installation, inspection and testing of the following per IBC Chapter 17. A minimum of 3 special inspections shall be performed (pre-construction, mid-construction, and final inspection):
 - I. Seismic Design Category C
 - a. Heating, ventilating and air-conditioning (HVAC) ductwork containing hazardous materials or smoke control and anchorage of such ductwork.
 - b. Piping systems and mechanical units containing flammable, combustible or highly toxic materials.
 - c. Anchorage of electrical equipment used for emergency or standby power systems.

- d. Vibration-isolated systems and associated seismic restraints where indicated on the construction documents or submittals. All restraints require a nominal clearance of 0.25 inch or less between the equipment support frame and restraint.

2. Seismic Design Category D

- a. All systems required for Seismic Design Category C
- b. Exterior wall panels and their anchorage
- c. Suspended ceiling systems and their anchorage
 - i. Verify member type and size, verify that bracing elements such as splayed wires and compression struts are installed as detailed; test anchorage to structure
- d. Steel storage racks 8 feet or higher
 - i. Verify that connections of the racks to the structure are installed as detailed on the Shop Drawings. Spot check the connection of horizontal beams to uprights verifying fastener tightness
- e. Access floors
 - i. Verify that anchorage matches detail on the Shop Drawings
 - ii. Verify connection of access floor framing to support posts
 - iii. Inspect installation of post-installed anchors
 - iv. Test post installed anchors

3. Seismic Design Categories E and F

- a. All systems required for Seismic Design Categories C and D
- b. All electrical equipment

I.09 FIELD QUALITY CONTROL

A. Special Seismic Certifications

- 1. Verify that the label, anchorage and mounting conform to the Certificate of Compliance for designated seismic systems.

I.10 PROJECT SEISMIC DESIGN CRITERIA

A. Seismic Design Category – [A] [B] [C] [D] [E] [F]

B. Seismic Design Force – Calculation of seismic design force shall be based on the requirements of ASCE 7 including Chapter 11 through Chapter 15 with the following seismic design parameters:

- 1. $S_s = X.XXX$ Mapped Short Period Spectral Response Acceleration Parameter
- 2. $S_1 = X.XXX$ Mapped 1 s. Spectral Response Acceleration Parameter
- 3. $S_{DS} = X.XXX$ Design Short Period Spectral Response Acceleration Parameter

4. $S_{D1} = X.XXX$ Design I s. Spectral Response Acceleration Parameter
 5. $[S_v = X.XXX$ Peak Spectral Response Vertical Acceleration Parameter]
 6. $I_{\text{building}} = X.XX$ Building or Structure Importance Factor
 7. $I_p = X.X$ Component Importance Factor
- C. Seismic Relative Displacement – Design shall accommodate seismic relative displacement of 0.02 times the story height in addition to thermal movement that may be present.
- D. Seismic Separation between Independent Structures – Components crossing seismic separations shall be designed to accommodate relative seismic movement between structures. Locations of seismic separations are shown on the drawings. Use the following to determine the range of movement required at each floor. Components shall be independently anchored to each structure.
1. $\Delta A1-B1 = XX"$ (i.e., $\pm xx"/2$)
 2. $\Delta A2-B2 = XX"$ (i.e., $\pm xx"/2$)
 3. $\Delta A3-B3 = XX"$ (i.e., $\pm xx"/2$)
 4. $\Delta A\text{Roof}-B\text{Roof} = XX"$ (i.e., $\pm xx"/2$)

PART 2 PRODUCTS

2.01 MATERIALS

- A. Anchor Bolts and Post-Installed Anchors
1. Cast-in anchor bolts or headed studs shall be used whenever possible. Cast-in anchor bolts and headed studs shall be designed in accordance with Section 1912 of the IBC and ACI 318 Appendix D. Post installed expansion anchors shall not be used for critical fastening such as vibrating conditions and impact loads.
 2. Expansion or sleeve anchors: Pre-qualified for use in seismic applications per ASTM E488 and current ICC-ES evaluation reports.
 3. Adhesive anchors: Pre-qualified for use in seismic applications per ASTM E488 and current ICC-ES evaluation reports.
 4. [For components weighing over 400 pounds, the minimum anchor size shall be 5/8-inch with minimum 5 inch embedment.]
 5. [For all components weighing less than 400 pounds, the minimum anchor size shall be 3/8inch diameter with minimum 3-inch embedment.]

PART 3 EXECUTION

3.01 COORDINATION

- A. Do not fabricate or install seismic restraints or non-building structures until submittals have been approved by the City.
- B. Verify that multiple systems installed in the same vicinity can be installed without conflict.

- C. Verify tolerances between installed items to confirm that unbraced components will not come into contact with restrained equipment or structural members during an earthquake. When contact is possible, provide seismic restraint or provide justification to the satisfaction of the City that contact will not cause unacceptable damage to the components in contact, their supports, finishes or other elements that are contacted.

3.02 DESIGN AND GENERAL CONSTRUCTION

- A. Components and their supports, non-building structures and designated seismic systems shall be attached or anchored to the structure. A continuous load path of sufficient strength and stiffness between the component and the supporting structure shall be provided.
- B. Design equipment support and bracing to resist seismic design force in any direction.
- C. Furnish and install supports, braces, connections, hardware and anchoring devices to withstand code-required seismic forces and seismic deformations without shifting or overturning.
- D. For components with $I_p = 1.5$, in addition to providing for code-required seismic forces and deformations, provide installations capable of providing post-earthquake functionality.
- E. Component attachments in accordance with ASCE 7 Chapter 13 shall be bolted, welded or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
- F. Where equipment is mounted on vibration isolators and restraints, use isolators and restraints designed for amplified code forces per ASCE 7 and with demonstrated ability to resist required forces including gravity, operational and seismic forces.
- G. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a Certificate of Compliance verified and listed by an accredited Inspection Agency is acceptable. Use of a certified product does not preclude the requirement for Shop Drawings.
- H. Design piping, piping risers, ducts and duct risers to accommodate interstory drift.
- I. Provide flexible connections between floor-mounted equipment and suspended piping; between unbraced piping and restrained suspended items; as required for thermal movement; at building separations and seismic joints; and wherever relative differential movements could damage piping in an earthquake.
- J. Where piping is explicitly exempt from seismic bracing requirements, provide flexible connections between piping and connected equipment, including in-line devices such as VAV boxes and reheat coils.
- K. Where piping is explicitly exempt from seismic bracing requirements, install piping such that swinging of the pipes will not cause damaging impact with adjacent components, finishes or structural framing. This will be considered satisfied if there is horizontal clear distance of at least $2/3$ the hanger length between subject components. If swinging of exempted piping can cause damaging contact with adjacent components, finishes or structural framing, add swing restraints as required to eliminate contact.
- L. For ductwork, provide independent support for in-line devices weighing more than 20 pounds. Provide independent support and bracing for all in-line devices weighing more than 75 pounds. Unbraced piping attached to braced in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.

M. Tanks

1. Design tank to resist seismic design forces.
2. Design tank anchorage to resist seismic design forces.
3. Design tank legs or supporting structure to resist seismic design forces.
4. Provide flexible connections between tank and interconnected piping.

N. Fire suppression equipment and piping

1. See requirements for piping.
2. See requirements for equipment.
3. Satisfy requirements of NFPA 13 and the force and displacement requirements of ASCE 7. All components shall be UL listed.
4. Provide end of line restraint as required by NFPA 13.

O. Conduit, cable tray, bus duct, raceways, bundled cabling

1. Provide gravity support for conduit/cable tray/bus duct/raceway/bundled cabling that is independent of suspended ceiling framing.
 2. Provide seismic bracing of conduit/cable tray/bus duct/raceway/bundled cabling to resist gravity and seismic design forces.
 3. Design conduit/cable tray/bus duct/raceway/bundled cabling to accommodate interstory drift.
- P. As an alternate to project-specific design of seismic bracing, use of proprietary restraint systems with a Certificate of Compliance verified and listed by an accredited Inspection Agency is acceptable. Use of a certified product does not preclude the requirement for Shop Drawings.
- I. Provide flexible connections wherever relative differential movement could damage conduit/cable tray/bus duct/raceway/bundled cabling in an earthquake.

END OF SECTION

NOTE: This section is used when the contract documents include a requirement for engineering design of a structure subject to a wind load. Some potentially applicable structures are included as examples. This section should be edited by a structural engineer. Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4614

WIND DESIGN CRITERIA

PART I GENERAL

I.01 SCOPE OF WORK

- A. Provide structural design due to the action of wind for project components and systems to be designed by performance specification. Design of all components and systems shall be done by a Professional Engineer engaged by and at the expense of the Contractor.
- B. This Section contains requirements regarding applicable codes, basis of design, and load criteria to be used in the detailed design of project components and systems to be designed under other Sections.
- C. Furnish calculations for all loads and load combinations as specified herein.
- D. The wind design criteria specified herein apply to the design of the following components and systems, and other components and systems specified under other Sections:

NOTE: Add or delete to match project requirements

- 1. Pre-engineered Metal Buildings
- 2. Pre-engineered Metal Canopies
- 3. Pre-engineered Precast Buildings
- 4. Pipes and Pipe Supports
- 5. Tanks and Platforms/Stairs
- 6. Equipment and Equipment enclosures
- 7. Free Standing Walls
- 8. Rooftop Equipment
- 9. Chimneys
- 10. Signs

I.02 RELATED WORK

NOTE: The following Paragraph should be used only to reference other Sections or Divisions that have a major impact on the design or bidding requirements of this Section. Include items that are furnished by others or the City for installation under this Section; items that are installed under other Sections or by others but furnished herein; and items that could possibly affect the way a bid is prepared if responsibility is not clear. Add to or delete from as required.

- A. [Seismic Design Requirements are included in Section 4612.]
- B. []
- C. []
- D. []

I.03 SUBMITTALS

- A. Submit, in accordance with Section 4300, design calculations and Shop Drawings, including the following:
- B. Calculations signed and sealed by a professional civil or structural engineer registered in the State of Louisiana for project records.
- C. Detailed Shop Drawings showing complete plans, elevations, sections, details and connection details or anchor bolt details as applicable. Submittals shall be clear and legible and of sufficient size for presentation of data.

I.04 REFERENCE STANDARDS

- A. International Code Council (ICC)
 - 1. International Building Code (IBC) 20xx
 - 2. ICC Evaluation Service Evaluation Reports
- B. [ASCE 7 –xx Minimum Design Loads for Buildings and Other Structures]

I.05 SYSTEM DESCRIPTION

- A. The following basic wind design criteria shall be used in all calculations. All other factors shall be determined in accordance with ASCE 7.

NOTE: Insert basic wind speed

- 1. Wind Speed: $V = [146]$ miles per hour.

NOTE: Insert wind exposure category. ASCE 7-05 §6.5.6 or ASCE 7-10 §26.7

- 2. Wind Exposure Category: [C]

NOTE: Insert importance factor if ASCE 7-05 table 6-1. Delete entire line if ASCE 7-10.

- 3. [Importance Factor: 1.15.]

NOTE: [Specifier Note: Use the following section for ASCE 7-05.]

- B. Use Method 2 – Analytical Procedure with the Low –Rise or Envelope Provisions of ASCE 7 Chapter 6 for the following structures:
 - 1. Pre-engineered Metal Buildings
 - 2. Pre-engineered Metal Canopies

NOTE: [Specifier Note: Use the following section for ASCE 7-05.]

- C. Use Method 2 – Analytical Procedure with the All Heights or Directional Provisions in accordance with ASCE 7 Chapter 6 for the following structures:
1. Pre-engineered Precast Buildings
 2. Pipes and Pipe Supports
 3. Tanks and Platforms/Stairs
 4. Equipment and Equipment enclosures
 5. Free Standing Walls
 6. Rooftop Equipment
 7. Chimneys
 8. Signs
 9. All other structures not specifically listed

NOTE: [Specifier Note: Use the following section for ASCE 7-10.]

- D. Use Envelope Procedure in accordance with Chapters 28 and 30 of ASCE 7 for the following structures:
1. Pre-engineered Metal Buildings
 2. Pre-engineered Metal Canopies

NOTE: [Specifier Note: Use the following section for ASCE 7-10.]

- E. Use Directional Procedure in accordance with Chapters 27, 29, and 30 of ASCE 7 for the following structures:
1. Pre-engineered Precast Buildings
 2. Pipes and Pipe Supports
 3. Tanks and Platforms/Stairs
 4. Equipment and Equipment enclosures
 5. Free Standing Walls
 6. Rooftop Equipment
 7. Chimneys
 8. Signs
 9. All other structures not specifically listed

I.06 COMBINATION OF LOADS

NOTE: Edit to match project

- A. Wind loads shall be used in combination with all other applicable design loads including but not limited to: dead loads, live loads, rain loads, snow loads, ice loads, seismic loads, flood

loads, earth and ground water pressures, and self-straining in accordance with the load combinations of ASCE 7 and the project building code.

- B. The most severe distribution, concentration and combination of design loads and forces shall be determined and then used in the design in accordance with the project building code. Some combinations of design loadings can be eliminated based on practical considerations. The referenced codes permit stress increases for some combinations but not for others. Design to meet code requirements and to satisfy all combinations of loads.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products shall meet the requirements of the project building code.
- B. All anchors shall be used in accordance with current ICC Evaluation Service Evaluation Reports.

PART 3 EXECUTION

3.01 GENERAL

- A. Wind design criteria shall be used in conjunction with the appropriate load factors and load combinations in accordance with ASCE 7 and the project building code.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4630

SUBSTITUTIONS AND PRODUCT OPTIONS

PART I GENERAL

I.01 REQUIREMENTS INCLUDED

- A. The requirements of this Section apply to proposed Substitute Items. If in the sole discretion of the Engineer an item of material or equipment proposed by the Contractor does not qualify as an "or-equal" item, it will be considered a proposed Substitute Item. This Section includes supplementary requirements to those in the General Provisions.
- B. The requirements of this Section do not apply to potential Suppliers or Bidders. Proposed Substitute Items will be accepted only from the Contractor.

I.02 SUBMITTALS

NOTE :The intention of this paragraph is to get early notice of proposed substitutions for major process equipment items for a facilities project, and to make a final decision on acceptance of the substitute early in the project in case significant redesign will be involved. There can be minor product substitutions that do not involve significant redesign. The number of days inserted in this paragraph should be carefully evaluated for each project. Submit a list of proposed Substitute Items within [30] days of Notice of Intent to Award.

- A. In order for proposed Substitute Items to be considered, the Contractor shall submit, within [30] days of Notice to Proceed, complete data as set forth herein to permit complete analysis of all proposed Substitute Items identified on the list. Proposed substitutions will not be considered unless the Contractor provides all of the required information within the [30] day period.
- B. Furnish a separate submittal for each proposed Substitute Item. Each submittal shall include the following information.
 - I. Complete data substantiating compliance of the proposed Substitute Item with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - i Product description.
 - ii Reference standards.
 - iii Performance and test data.
 - iv Operation and maintenance data.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.

2. Itemized comparison of the proposed Substitute Item with product specified. List significant variations. Substitution shall not change design intent and shall perform equal to that specified.
3. Data relating to impact on construction schedule occasioned by the proposed substitution.
4. Any effect of substitution on separate contracts.
5. List of changes required in other work or products.
6. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any net change to Contract Amount.
7. Designation of required license fees or royalties.
8. Designation of availability of maintenance services, sources of replacement materials.

I.04 EVALUATION OF PROPOSED SUBSTITUTE ITEMS

- A. Substitutions will not be considered for acceptance when:
 1. They are indicated or implied on shop drawings or product data submittals without a
 2. They are requested directly by a Subcontractor or Supplier.
 3. Acceptance will require substantial revision of Contract Documents.
- B. Requests for substitutions which are not included on the list of proposed Substitute Items will not be considered unless evidence is submitted to the City that all of the following circumstances exist:
 1. The specified product is unavailable for reasons beyond the control of the Contractor. Such reasons shall consist of strikes, bankruptcy, discontinuance of manufacturer, or acts of God.
 2. The Contractor placed, or attempted to place, orders for specified products within 30 days after Notice to Proceed
 3. Request for substitution is made in writing to the Engineer within 10 days of the date on which the Contractor ascertains that it cannot obtain the specified item.
 4. Complete data as set forth herein to permit complete analysis of the proposed substitution is submitted with the request.
- C. The Engineer's decision regarding evaluation of substitutions shall be considered final and binding. Requests for time extensions and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed. All approved substitutions will be incorporated into the Contract by Change Order.

I.06 CONTRACTOR'S REPRESENTATION

- A. In making formal request for substitution, Contractor represents that:
 1. It has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.

2. It will provide same warranties or bonds for substitution as for product specified.
3. It will coordinate installation of accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
4. It waives claims for additional costs caused by substitution which may subsequently become apparent.
5. Cost data is complete and includes related costs under his/her Contract, but not:
 - a. Costs under separate contracts.
 - b. City's costs for redesign or revision of Contract Documents.

I.07 ENGINEER DUTIES

- A. Review Contractor's requests for substitutions with reasonable promptness.
- B. Notify Contractor, in writing, of decision to accept or reject requested substitution.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 4700

CONTRACT CLOSEOUT

PART I GENERAL

I.01 SCOPE OF WORK

NOTE: Verify Sections below are part of Contract Documents, otherwise delete.

- A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:
 - 1. Final cleaning (Section 4710).
 - 2. As-Built Construction Schedule (Section 4310).
 - 3. Final cleaning (Section 4710).
 - 4. As-Built Drawings (Section 4720).
 - 5. Warranties, guarantees, and bonds (Section 4740).
 - 6. Spare parts and maintenance materials (as specified).
 - 7. Reconciliation of final accounting and summary change order.
 - 8. Final releases or waivers buildings, wells, utilities and railroads.
 - 9. Letter of Final Completion.
 - 10. Final Acceptance and Payment.

I.02 RELATED WORK

- A. Completion (Standard Specification Section 110.12).
- B. Acceptance and Final Payment (Standard Specification Section 111.8).

I.03 FINAL COMPLETION

NOTE: Edit this paragraph as appropriate for each project.

- A. Complete all Work, correct all deficiencies, and furnish all deliverables as specified, prior to Final Completion. The following list is not intended to be comprehensive, but includes examples of services and documentation which are part of the Work.
 - 1. Field services by material suppliers and manufacturers
 - 2. Initial operation and testing, performance testing, final acceptance testing
 - 3. Startup and performance demonstration
 - 4. Operating and maintenance instructions and manuals

5. Vendor training/instructions to City personnel
 6. Online training services
 7. Spare parts and maintenance materials
 8. As- Built Drawings
 9. As-Built Construction Schedule
 10. Warranties, guarantees, and bonds
 11. Final cleaning and site restoration
 12. Removal of project signs, temporary traffic control devices, and temporary facilities
 13. Establish permanent erosion control and remove temporary erosion control items
- B. Furnish submittals to Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.
 - C. When the Contractor determines that the Work is complete, it shall notify the City Engineer in writing that the Work will be ready for final inspection on a definite date. The notice shall bear the signed concurrence of the Engineer having charge of inspection and construction and shall be given at least 10 days prior to the date stated for final inspection. If the City determines that the Work is as represented, it will make arrangements to have final inspection commenced on the date stated or as soon thereafter as practical.
 - D. If the final inspection discloses any Work as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction. Upon correction of the Work, another inspection will be made, and will constitute the final inspection if the Work has been satisfactorily completed.
 - E. When the Work is found to be complete, the City will notify the Contractor and issue a Letter of Final Completion. The Contractor shall record the Letter of Final Completion with the Clerk of Court in Caddo Parish no later than 45 days after the date of Final Completion. The recording date begins the "45 day lien free period" which is the last 45 days during which anyone may file a lien against the contract.
 - F. The date of Final Completion is the end of accrual of Contract Time and Liquidated Damages. The following date is the beginning of time for warranties, guarantees, and the maintenance and repair period.

I.04 FINAL ACCEPTANCE AND PAYMENT

- A. If necessary to reconcile estimated and actual quantities of Contract Items, the City will prepare and execute a summary change order.
- B. Contractor shall furnish all releases or waivers on buildings, wells, utilities, and railroads, as well as any maintenance bonds, certificates from the Health Department, tracings, brochures, or other items required by the Contract before Final Payment.

- C. The City will acknowledge Final Acceptance of the Work and make final payment to the Contractor within 45 days following receipt of a clear lien certificate.
- D. For a paving assessment project, the City Council must approve and accept the Work and authorize final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

NOTE: This section includes requirements for interior and exterior surfaces, painted surfaces, glazing, mirrors, ventilation systems, and other items which are not applicable to all projects. Carefully review and edit this section for each project.

NOTE: Select or delete all information indicated by square brackets, then delete brackets around the item.

SECTION 4710

CLEANING

PART 1 GENERAL.

1.01 SCOPE OF WORK.

- A. Maintain the Site clean and free from rubbish and debris, including existing rubbish and debris identified in the Contract Documents to be removed. Execute cleaning of components of the Work during construction until final completion of the Project. No direct payment will be made for Work specified in this Section.

1.02 DISPOSAL AND CLEANING.

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.

PART 2 PRODUCTS.

2.01 MATERIALS.

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by manufacturer of the cleaning material.
- D. Earth dams will not be permitted at catch basin openings, local depressions, or elsewhere, except in time of emergency. Temporary dams of sand bags, asphaltic concrete, or other acceptable material may be permitted when necessary to protect the Work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the Site as soon as their use is no longer necessary.

PART 3 EXECUTION.

3.01 PRIOR TO CONSTRUCTION.

- A. Remove all existing waste material, rubbish and windblown debris identified in the contract documents from the work site prior to construction.

3.02 DURING CONSTRUCTION.

- A. Execute periodic cleaning to keep the Work, the Site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.

- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the Site.
- D. Remove materials and equipment from the Site as soon as they are no longer necessary.
- E. Remove excess materials from excavation of catch basins and similar structures immediately. Sufficient materials which meet the specified requirements for backfill may remain.
- F. [Remove forms and form lumber from the Site as soon as practicable.]

3.03 DUST CONTROL.

- A. [Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.]
- B. [Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.]

3.04 FINAL CLEANING.

- A. Employ skilled workmen for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed [interior and exterior] surfaces.
- C. [Wash and shine glazing and mirrors.]
- D. [Polish glossy surfaces to a clear shine.]
- E. Ventilating Systems:
 - 1. [Clean permanent filters and replace disposable filters if units were operated during construction.]
 - 2. [Clean ducts, blowers and coils if units were operated without filters during construction.]
- F. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- G. Prior to final completion or City occupancy, conduct an inspection of sight-exposed [interior and exterior] surfaces and all Work areas, to verify that the entire Work is clean.

END OF SECTION

NOTE: Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4720

AS-BUILT DRAWINGS

PART I GENERAL.

I.01 SCOPE.

- A. The Contractor shall keep and maintain, at the job site, a copy of the Drawings, marked up and annotated to indicate all changes made during the course of a project, as specified herein.
- B. The Contractor shall keep and maintain, at the job site, a copy of Point-to-Point Wiring Diagrams for control systems, marked up and annotated to indicate all changes made during the course of a project, as specified herein.

NOTE: Edit this paragraph as applicable to each project. Delete documents that will not be required, and add requirements if necessary.

I.02 REQUIREMENTS INCLUDED.

- A. Contractor shall maintain an as-built copy of the following documents, marked up to indicate all changes made during the course of a project:
 - 1. Drawings
 - 2. [Point-to-Point Wiring Diagrams]
 - 3. [Panelboard Circuit Directories]
- B. Measure and record coordinates representing the horizontal and vertical locations of all buried pressure pipelines 4 inches in diameter or larger. Measure horizontal and vertical locations of all fittings, valves, manholes and changes in horizontal direction and record the coordinates that these locations represent.

NOTE: This paragraph is intended for recording locations of new, major structures such as remote lift stations. It is not intended for typical manholes, drainage structures, or major structures within a treatment facility site. Identify applicable structures or delete this paragraph.

- C. Measure and record coordinates representing the horizontal locations of each corner of new, major structures including [list specific structures].
- D. Utilize equipment with sufficient horizontal positional accuracy to measure horizontal coordinates of each point so that the specific locations can be subsequently marked. The specific location of a pipeline is defined as an area not wider than the width of the pipeline plus 18 inches on either side. Measure and record the elevation of pipelines at each specific location to the nearest whole foot. [The specific location of a structure corner is defined as an area within an 18-inch radius of the actual corner.]
- E. Measure and record coordinates based on the Louisiana Coordinate System of 1983 North Zone. Measure and record elevations in Mean Sea Level datum.

NOTE: This portion of the specification is based on the presumption that the Engineer will modify the electronic drawings (AutoCAD) to produce Record Drawings.

F. AS-BUILT DRAWINGS

1. The Contractor shall annotate (mark-up) the Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Drawings. The as-built information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the Work, as constructed.
2. These annotated Drawings constitute the Contractor's As-Built Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.
3. As-Built Drawings shall be accessible to the Engineer at all times during the construction period.

PART 2 PRODUCTS (NOT USED).

PART 3 EXECUTION.

3.01 MAINTENANCE OF AS-BUILT DRAWINGS.

- A. Store As-Built Drawings in Contractor's field office apart from documents used for construction. Provide files and racks for storage of the As-Built Drawings.
- B. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.
- C. Make documents available for inspection by the Engineer at all times.

3.02 MARKING METHOD.

- A. Use the color Red (indelible ink) to record information on the Drawings.
- B. Label each document "AS-BUILT" in neat large printed letters.
- C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.
- D. Record information contemporaneously with construction progress.
- E. Legibly mark drawings with as-built information:
 1. Elevations and dimensions of structures and structural elements.
 2. All underground utilities (piping and electrical), structures, and appurtenances
 - a. Changes to existing structure, piping and appurtenance locations.
 - b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.

- c. Record actual installed pipe material, class, size, joint type, etc
- d. Record specific locations of buried pressure pipelines 4 inches in diameter or larger and corners of new, major structures in tabular form. Reference each specific location on the annotated Drawings.

3.03 AS-BUILT INFORMATION COMPILATION.

- A. Do not conceal any work until the required information is acquired.

NOTE: Revise the following paragraph as applicable to each project.

- B. Items to be recorded include, but are not limited to:
 - 1. [Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.]
 - 2. Field changes of dimensions and/or details
 - a. [Interior equipment and piping relocations.]
 - b. [Architectural and structural changes, including relocation of doors, windows, etc.]
 - c. [Architectural schedule changes.]
 - 3. Changes made by Field Order or Change Order
 - 4. Clarifications made from RFI's
 - 5. Details not indicated on the original Drawings
 - 6. [Notes regarding liners installed or other trenchless pipeline rehabilitation or repair]
 - 7. Coordinates of pipelines, manholes, bends, valves, horizontal changes in direction, and vertical changes in direction.

3.04 SUBMITTAL.

- A. Prior to Final Completion of the Work, the Contractor shall finalize and deliver a complete set of As-Built Drawings to the Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the Work. As-Built Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.
- B. The information submitted by the Contractor into the As-Built Drawings will be assumed to be correct. The Contractor shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data.
- C. Delivery of As-Built Drawings to the Engineer will be a prerequisite to Final Completion.

END OF SECTION

NOTE: This section includes requirements related to training services by 360water or similar service providers. Edit requirements as appropriate for each specific project. Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4730

OPERATION AND MAINTENANCE DATA AND TRAINING

PART I GENERAL

I.01 SCOPE OF WORK

- A. This Section includes procedural requirements for compiling and submitting operation and maintenance data, and vendor training and instructions to City personnel.

NOTE: Use this paragraph if training services by 360water or others are required. List specific items, systems, or section numbers.

- B. Provide customized online operation and maintenance training for the following items or systems.

1.

2.

I.02 OPERATING MANUALS

NOTE: If necessary, edit this paragraph to include items not clearly covered. Include one electronic copy for 360water in the number of copies required.

- A. Provide specific operation and maintenance instructions for all electrical, mechanical, instrumentation & controls items furnished under various technical specifications. Furnish separate manuals for each item, or each Section number.
- B. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following information: Contractor's name and address, City of Shreveport, project name, project number, submittal number, description of submittal and number of copies transmitted.
- C. Furnish [5] hard copies of each manual using the following materials.
1. Binders
 - a Commercial quality three ring binders with durable and cleanable plastic covers
 - b Maximum ring width capacity: 3 inches
 - c When multiple binders are used, correlate the data into related consistent groupings/volumes.
 2. Identification: Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:
 - a Title of Project.
 - b Identify the general subject matter covered in the manual.

- c Identify structure(s) and/or location(s), of the item provided.
 - d Specification Section number.
- 3. 20 lb. loose leaf paper, with hole reinforcement
- 4. Page size: 8-1/2 inch by 11 inch
- 5. Provide heavy-duty fly leaves (section separators), matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual
- 6. Provide reinforced punched binder tab; bind in with text
- 7. Reduce larger drawings and fold to the size of text pages – but not larger than 11 inches X 17 inches – or provide a suitable clear plastic pocket (with drawing identification) for each such folded drawing.
- D. Provide [2] electronic copies of each manual. Unless otherwise approved by the Engineer, O&M manuals may not be transmitted by electronic means other than USB flash drive. Electronic O&M manuals shall meet the following conditions:
 - 1. The specified transmittal form is included
 - 2. With the exception of the transmittal sheet, the entire submittal is included in a single file.
 - 3. Files are Portable Document Format (PDF) – with printing function enabled.
 - 4. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the pages are not crooked and all information is legible.
 - 5. The electronic copy of the O&M Manual must be identical in organization, format, and content to the hard copies of the manual.
 - 6. The electronic O&M manual must be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document must be indexed and searchable.
- E. Contents:
 - 1. A table of contents/Index, divided into section reflective of the major components provided.
 - 2. Specific description of each system and components
 - 3. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s)
 - 4. Specific on-site operating instructions (including starting and stopping procedures)
 - 5. Safety considerations
 - 6. Project specific operational procedures and recommended log sheet(s).
 - 7. Project specific maintenance procedures

8. Manufacturer's operating and maintenance instructions – specific to the project
9. Copy of each wiring diagram
10. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s)
11. List of spare parts and recommended quantities
12. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
13. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams
14. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
15. Warranties and Bonds, if required

NOTE: Manuals for Systems are not required for every project. Edit this paragraph as necessary or delete this paragraph if it is not applicable.

- F. Manuals for Systems – in addition to the requirements listed above, provide the following information for each system:
 1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include legible performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.
 2. Panelboard circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.
 3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
 4. Maintenance Requirements
 - a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions
 - b. Alignment, adjusting, balancing and checking instructions
 - c. Servicing and lubrication schedule and list of recommended lubricants
 - d. Manufacturer's printed operation and maintenance instructions
 - e. Sequence of operation by instrumentation and controls manufacturer
 - f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
 5. Control diagrams by controls manufacturer as installed (as-built)
 6. Contractor's coordination drawings, with color coded piping diagrams, as installed (asbuilt)

7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.
8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage
9. Test and balancing reports, as required
10. Additional Requirements as specified in individual product specification
11. Design data for systems engineered by the Contractor or its Suppliers

I.03 ONLINE TRAINING SERVICES

NOTE: Delete this paragraph if online training services are not required.

- A. Provide services by a subcontractor specializing in customized online training for water and wastewater systems and equipment.
- B. Contractor shall require vendors and manufacturers to furnish materials and information necessary for use by the online training service provider including product brochures, startup and shutdown procedures, information on operation and maintenance of each item or system, a troubleshooting guide, and additional material or literature available to assist the City in properly operating and maintaining each item or system.
- C. Contractor shall require vendors and manufacturers to review the courseware written for items they are supplying, and to provide comments and corrections in a timely manner.

PART 2 PRODUCTS

2.01 ONLINE TRAINING SERVICES

- A. Provide course work, hosting services, and programming for online training. Develop online learning modules, prepare quizzes and a test with the full cooperation of each manufacturer.
- B. Develop Online Learning Modules to evaluate and test operators on the following concepts.
 1. Startup and Shutdown of equipment
 2. Basic operations, maintenance, and safety
 3. Troubleshooting techniques
- C. Provide an Online Education Program including the following functions.
 1. Intermittent quizzes and test questions
 2. Wrong answer notification
 3. 100 percent proficiency required before a certificate of completion is generated
 4. A real time clock on screen that verifies the time spent on the course material
 5. The software program will automatically bookmark when the operator leaves a course (in the event of a power outage or emergency in the facility)

6. The online education platform must be previously approved by the state-regulating agency for continuing education. This is in the event that the City chooses to apply for CH/CEU credits for its training program.
- D. The hosting of this service shall last a minimum of 5 years. Course work, hosting services, and programming shall be provided by 360water, Inc. or approved equal. Any equal service provider must reprogram existing online courses onto its site so that all Shreveport employees go to the same site to see the entire Shreveport library. Provide a list of at least 10 municipal installations with contact names and telephone numbers where the service provider has completed similar technical training for water and wastewater personnel.

2.02 ELECTRONIC O&M INTERFACE

- A. Develop graphical interface screens as part of the training website to be programmed concurrently with the training modules themselves. These screens will show hyperlinks to the O&M materials which will be hosted on the training website. The Shreveport map feature will allow the user to see the location of each piece of equipment. Hyperlinks connecting the user from the map feature to the electronic O&M materials will be created. The site will link training to the appropriate O&M PDFs. Dropdown menus should be used to organize all content on the site for ease of navigation.
- B. The website, the online courses, and the O&M documents, shall all be viewable using the most current version of the following web browsers: Internet Explorer, Chrome, and Firefox. However, documents will only be browser-viewable provided the end user has the appropriate plug-in installed for the given file type (e.g. Adobe Acrobat Reader for PDF files). In addition, O&M documents shall always be offered with the option of downloading as well.

2.03 DATA CAPTURE

- A. The Online Training Service provider shall schedule [] days broken up into [] trips to the Site. During these visits the data capture personnel will capture digital images and video for the courseware. During one of the trips, the Online Service Provider shall review some of the courseware with the City training liaison, an operation supervisor, and maintenance supervisor to demonstrate the review process that will be conducted in house by the City.

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

- A. A. Furnish preliminary copies of each manual to the Engineer, no later than [60] days following approval of the respective shop drawings. Provide final copies of each completed manual prior to shipping.
- B. The Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Section. The review will generally be based on the O&M Manual Review Checklist appended to this Section.
- C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the Contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO CITY'S PERSONNEL)

- A. Before final initiation of operation, Contractor's vendors shall train/instruct City's designated personnel in the operation, adjustment, and maintenance of products, equipment and systems as recommended by the respective manufacturers at times convenient to the City. Training may not proceed until the O & M manual has been approved. Contractor's vendors will use the approved O & M manual during training as reference material.

NOTE: Specific number of hours for instructions, where required, should be specified in technical Section. Eight hours of training are unnecessary and excessive for some items.

- B. Unless specified otherwise under the respective equipment specification section, vendor training/instruction shall consist of [eight] hours of training for each type of equipment. Such training/instruction shall be scheduled and held at times to accommodate the work schedules of City's personnel, including splitting the required training/instruction time into separate sessions and/or presented at reasonable times other than the Contractor's "normal working hours" or the City's normal day shift.
- C. Use operation and maintenance manuals as basis for instruction. Train/instruct the City's personnel, in detail, based on the contents of manual explaining all aspects of operation and maintenance of the equipment. If the respective equipment is inter-related to the operation of other equipment, all interlock, constraints, and permissives shall be explained.
- D. At least two weeks prior to the scheduled date for vendor training, a detailed lesson plan, representative of the material to be covered during instruction, shall be submitted to the Engineer for approval. Lesson plans shall consist of in-depth outlines of the training material, including a table of contents, resume of the instructor, materials to be covered, start-up procedures, maintenance requirements, safety considerations, and shut-down procedures.
- E. Prepare and insert additional data in each Operation and Maintenance Manual when the need for such data becomes apparent during training/instruction.
- F. Vendor's training/instruction will be considered acceptable based on the completed City Acknowledgement of Manufacturer's Instruction at the end of this Section.

3.03 VIDEOGRAPHY OF VENDOR TRAINING/INSTRUCTION

NOTE: Consider video recording instructions for complicated equipment or systems. Obtain City's approval of video recording because it might be expensive. Delete if not required.

- A. Audio/video (A/V) record (in DVD format) training/instructions as they are being provided to the City's personnel. Such recording shall include the entire training/instruction session(s) as well as all questions and answers. A/V recording shall be performed by a professional organization experienced in the production of such recordings. Self-recording by the Contractor may be considered, provided that Contractor can demonstrate, in advance, proficient examples of such recordings.
- B. To avoid audio problems, training/instruction shall be held in a location sufficiently removed from construction activity, insulated from the noise of construction activity, or during a time when construction activity is not occurring in the vicinity.
- C. The audio portion of the A/V recording should be done with a microphone (wired or wireless) attached to the trainer/instructor to maximize the quality of speech.

- D. Each A/V recording should have "chapters" to segregate the distinct portions of the training/instruction, or have visual cues at the start of a change in subject.
- E. Two copies of the A/V recordings shall be submitted to the Engineer on DVD disk(s). The DVDs will become the property of the City.
- F. The video camera will record the presentation material (close up) with the audio portion to simulate the presentation. When a physical demonstration is being conducted the camera will be repositioned to capture that portion as well

NOTE: Use the following paragraphs only for projects with online training services.

3.04 ELECTRONIC O&M INTERFACE

- A. Develop graphical interface screens as part of the training website to be programmed concurrently with the training modules themselves. These screens will show hyperlinks to the O&M materials which will be hosted on the training website. The Shreveport map feature will allow the user to see the location of each piece of equipment. Hyperlinks connecting the user from the map feature to the electronic O&M materials will be created. The site will link training to the appropriate O&M PDFs. Dropdown menus should be used to organize all content on the site for ease of navigation.
- B. The website, the online courses, and the O&M documents, shall all be viewable using the most current version of the following web browsers: Internet Explorer, Chrome, and Firefox. However, documents will only be browser-viewable provided the end user has the appropriate plug-in installed for the given file type (e.g. Adobe Acrobat Reader for PDF files). In addition, O&M documents shall always be offered with the option of downloading as well.

3.05 DATA CAPTURE

- A. The Online Training Service provider shall schedule [] days broken up into [] trips to the Site. During these visits the data capture personnel will capture digital images and video for the courseware. During one of the trips, the Online Service Provider shall review some of the courseware with the City training liaison, an operation supervisor, and maintenance supervisor to demonstrate the review process that will be conducted in house by the City.

3.06 FACE TO FACE TRAINING REVIEW

- A. Online Training Service personnel involved in the writing of the courseware shall attend a training session provided by each manufacturer. The purpose is to document any additional information stated but not captured in the O&M manual as well as to identify any discrepancies or contradictions with the materials. These trips will coincide with the data capture visits.
- B. Provide comments and notes to the Engineer. The Engineer will decide if the contradictions or discrepancies warrant a return visit from the manufacturer's representative to clarify comments.

END OF SECTION

O&M Manual Review Checklist

Submittal No.: _____
Manufacturer: _____

Project No.: _____

Item Submitted: _____ Specification Section: _____ Date of Submittal: _____

General Data

1. Are the area representative's name, address, e-mail address and telephone number included?
2. Is the nameplate data for each component included?
3. Are all associated components related to the specific equipment included?
4. Is non-pertinent data crossed out or deleted?
5. Are drawings neatly folded and/or inserted into packets?
6. Are all pages properly aligned and scanned legibly?
7. Is the .PDF document bookmarked according to the table of contents?

Operations and Maintenance Data

8. Is an overview description of the equipment and/or process included?
9. Does the description include the practical theory of operation?
10. Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?
11. Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?
12. Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?
13. Is a list of operational parameters to monitor and record specific to the equipment provided included?
14. Is a proposed operating log sheet specific to the equipment provided included?
15. Is a spare parts inventory list included for each component?
16. Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state "No Lubrication Required"?
17. Is a maintenance schedule for each component specific to the equipment provided included?
- 18.. Is a copy of the warranty information included?

Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____
- 7. _____
- 8. _____
- 9. _____
- 10. _____
- 11. _____
- 12. _____
- 13. _____
- 14. _____
- 15. _____

Reviewed By _____ Date: _____

Legend

1 = OK

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

CITY ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION

CITY OF SHREVEPORT PROJECT :

SPECIFICATION SECTION _____

SUBJECT DESCRIPTION _____

TRAINING DATES AND TIMES _____

TRAINING PROVIDED BY

Name_____

Company_____

Contact Information_____

CITY ACKNOWLEDGEMENT

The City of Shreveport acknowledges receipt of training and instruction as recommended by the manufacturer(s) for the subject items.

City Representative (Sign, Print Name and Title)

Date_____

END OF SECTION

NOTE: Edit this section for each project Insert or select all information indicated by square brackets, then delete brackets around the item.

SECTION 4740

WARRANTIES AND BONDS

PART I GENERAL.

I.01 SCOPE OF WORK

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

I.02 SUBMITTALS.

- A. Submit written warranties to the City prior to the date fixed by the City for Final Completion. If the Certificate of Final Completion designates a commencement date for warranties other than the date of Final Completion for the work, or a designated portion of the work, submit written warranties upon request of the Engineer.

NOTE: Revise this paragraph, particularly in the event of partial occupancy. Sometimes extended warranties may be necessary

- B. When a designated portion of the work is completed and occupied or used by the City, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the City within 15 days of completion of that designated portion of the Work.

NOTE: Retain this paragraph for the special warranty required in General Provision 103.5 and any other special warranties.

- C. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the City for approval prior to final execution.

NOTE: Retain this paragraph with the preceding paragraph.

- D. Refer to the General Provisions, Special Conditions for Streets/Drainage and Water/Sewer and individual Technical Specification Sections for specific content requirements, and particular requirements for submittal of special warranties and bonds.

At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Contract Documents.

NOTE: Delete Paragraphs F thru K for small projects with only a few warranties.

NOTE: Modify the Paragraphs F through K to satisfy special project requirements.

- E. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents and sized to receive 8-1/2in by 11-in paper.

- F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Contract Documents, with each item identified with the number and title of the Section in which specified and the name of the product or work item.
- G. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address and telephone number of the installer, supplier and manufacturer.
- H. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name and the name, address and telephone number of the Contractor.

NOTE: Coordinate the requirement below with section "Project Closeout" or "Operating and Maintenance Data." Make certain there are sufficient copies of warranties for inclusion in the manuals.

- I. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

NOTE: List all required special warranties below. See Paragraph I.04 for definition of special warranties. Verify that each Section listed contains a cross reference to this Section and names the products and type of submittals required.

- J. Schedule of Special Warranties
 - 1. General Provision 103.5- Guarantees
 - 2. Section [_____ - _____].
- K. Maintenance Bond: Furnish a two-year 10 percent maintenance bond as required in Special Conditions for Streets/Storm Drainage and Water/Sewer 5.4.

NOTE: Modify or delete the following requirements.

I.03 WARRANTY REQUIREMENT.

- A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the City has benefited from use of the work through a portion of its anticipated useful service life.
- D. City's Recourse: Written warranties made to the City are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise

available under the law, nor shall warranty periods be interpreted as limitations on time in which the City can enforce such other duties, obligations, rights, or remedies.

- E. Rejection of Warranties: The City reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- F. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.

I.04 DEFINITIONS.

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the City.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the City.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION