



**CITY OF LINCOLN
STANDARD SPECIFICATIONS
for
MUNICIPAL CONSTRUCTION
2020**



Coordinating Professional

Lincoln Transportation and Utilities Department
Lincoln Parks and Recreation Department
Lincoln Electric System

These Standard Specifications are effective on all Construction
Projects with Bid Opening on or after January 2, 2020.

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I. DEFINITIONS AND TERMS

A. GENERAL

The General Conditions and Requirements and Contract stipulations may refer to conditions which will not be encountered in the performance of Work included in this Contract and which are not applicable thereto. Any requirements, provisions, or other stipulation of these General Conditions and Requirements which pertain to a non-existent condition and are not applicable to the Work to be performed hereunder shall have no meaning in this Contract.

The Special Provisions shall govern in case of any conflicts between the General Conditions and Requirements and the Special Provisions.

B. ABBREVIATIONS

The following abbreviations, when appearing in the Contract Documents, shall be construed to be the same as their respective expressions:

AAP	-	Affirmative Action Plan
AASHTO	-	American Association of State Highway and Transportation Officials
AC	-	Alternating Current
ACI	-	American Concrete Institute
ADA	-	Americans with Disabilities Act
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASA	-	American Standards Association
ASTM	-	American Society for Testing and Materials
AWG	-	American Wire Gauge
AWS	-	American Welding Society
AWWA	-	American Water Works Association
BC	-	Bundled Cable
Db	-	Decibel
EEI	-	Edison Electric Institute
EEO	-	Equal Employment Opportunity
EIA	-	Electronic Industries Association
FHWA	-	Federal Highway Administration
GRS	-	Galvanized Rigid Steel
HDPE	-	High Density Polyethylene
HZ	-	Hertz
ICEA	-	Insulated Cable Engineers Association
IEC	-	International Electrotechnical Commission
IES	-	Illuminating Engineering Society
IMSA	-	International Municipal Signal Association
IPCEA	-	Insulated Power Cable Engineers Association
IPS	-	Iron Pipe Size
ISO	-	International Standards Organization
LED	-	Light-emitting diode
LES	-	Lincoln Electric System
LPD	-	Lincoln Police Department
LSP	-	Lincoln Standard Plan
MUTCD	-	Manual Uniform Traffic Control Devices
NDOT	-	Nebraska Department of Transportation
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electrical Safety Code

I. DEFINITIONS AND TERMS (Continued)

B. ABBREVIATIONS (Continued)

NM	-	Nanometer
OSHA	-	Occupational Safety and Health Administration
OTDR	-	Optical Time Domain Reflectometer
PVC	-	Polyvinyl Chloride
RMS	-	Root Mean Squared
SCTE	-	Society of Cable Telecommunications Engineers
SJOW	-	Stranded Junior service Oil-resistant Weather-resistant
SSP	-	State Standard Plan
TCLP	-	Toxicity Characteristic Leaching Procedure
THHN	-	Thermoplastic High Heat-resistant Nylon-coated
TIA	-	Telecommunications Industry Association
UL	-	Underwriters Laboratories
USASI	-	USA Standards Institute
UV	-	Ultraviolet

C. DEFINITIONS

1. **Addendum** (Addenda). Additional documents, issued by the City to prospective Bidders prior to the closing date for receipt of bids, which are intended to change or clarify the original plans and/or specifications, i.e., additions, deletions, modifications, or explanations.
2. **Advertisement** The public announcement, stating the time and place for receiving bids for the Work.
3. **Assistant Director of Transportation (City Engineer)** Only the City Engineer or his/her duly authorized representatives.
4. **Beginning of Work** Performing Work on site which may include, but is not limited to, material and equipment staging, construction entrance and other erosion control best management practices installation, utility potholing, placing traffic control, saw cutting, excavation, pavement removal and similar Work that is shown on the plans and as specified
5. **Bid** shall mean the properly signed and guaranteed written offer of the Bidder to perform the Work. Bid shall include Proposals or other formal written offers to perform the Work.
6. **Bidder** shall mean any individual, entity, firm, partnership, or corporation formally submitting a proposal to perform the Work or to supply materials for the Work. Bidder shall include any of the same acting through an authorized agent or representative.
7. **Brand Name** Wherever in the specifications or proposal form brand names, manufacturer, trade name, or catalog numbers are specified, it is for the purpose of establishing a grade or quality of material only; and the term "or equal" is deemed to follow.
8. **Business Day** Every official work day which normal business operations are conducted, Monday through Friday, except legal holidays observed by the City (see City Holiday).
9. **Calendar Days** Every day shown on the calendar. (Saturdays, Sundays and Holidays included).

I. DEFINITIONS AND TERMS (Continued)

C. DEFINITIONS (Continued)

10. **Change Order** shall mean a written instrument the City's Project Manager issues and the Mayor and the Contractor approve to state the City and Contractor's agreement for a change in the Work. All Change Orders shall specify the method of payment, if any. All Change Orders shall specify adjustments in the Contract Sum and/or Contract Time, if any.
11. **City** The City of Lincoln, Nebraska, and shall include the City's authorized representative.
12. **City Holiday** A City Holiday shall be defined as those holidays observed by the City as authorized in Section 2.76.370 of the Lincoln Municipal Code
13. **City's Project Manager** shall be the person designated by the Department Director bidding the Project. The City's Project Manager is acting as an agent of the City during the construction period and shall decide all questions which may arise as to Contract fulfillment on the part of the Contractor. The City's Project Manager may be either City employee or Consultant.
14. **City's Engineering Inspector** is an appointed agent of the City's Project Manager to inspect all Work done. The City's Engineering Inspector is appointed for the benefit of the City and any inspections shall be for the benefit of the City. The City's Engineering Inspector may be either City employee or Consultant.
15. **Claim** shall include a demand or assertion by the City or the Contractor seeking an adjustment to or interpretation of Contract terms, payment, time or other matters related to the Contract. The party making the Claim shall substantiate any such Claim.
16. **Consultant** shall mean the designated architect, engineer, or professional contracted by the City to provide design, construction, and/or other professional services related to the project.
17. **Contract** The written agreement between the City and the Contractor, containing all the covenants of that agreement. Contract Documents shall include the Contract, Conditions of the Contract (General, Supplementary and other conditions), Drawings, Specifications, addenda issued prior to execution of the Contract, other documents listed in the Contract and modifications or other agreements required to complete the Work issued after execution of the Contract. Unless specifically excluded in the Contract, Contract Documents shall also include the bidding requirements, Advertisement, Instructions to Bidders, sample forms, Contractor's Bid and Addenda.
18. **Contract Bonds** The approved forms of security, executed by the Contractor and his surety or sureties, guaranteeing complete execution of the Contract and the payment of all legal debts pertaining to the Contract.
19. **Contractor** The individual, entity, firm, partnership, or corporation undertaking the execution of the Work under the terms of the Contract who, regardless of any of the Contract terms, is always considered as an independent contractor.
20. **Contract Completion Date** The calendar date stipulated in the Contract by which the proposed Work shall be complete.
21. **County** Lancaster County, Nebraska.
22. **Easement** A right to use or control property for a designated purpose.

I. DEFINITIONS AND TERMS (Continued)

C. DEFINITIONS (Continued)

23. **Engineer** An individual who is professionally licensed in Nebraska.
24. **Equipment** All machinery, tools, supplies necessary for maintenance, and apparatus necessary for the construction of the Work.
25. **Extra Work** An item of Work not originally a part of the Contract, but necessary for completion and/or execution of the Contract.
26. **Final Completion** The stage when the City determines that the Work has been totally completed in accordance with the terms and conditions of the Contract Documents.
27. **General Conditions** Standard provisions for all City Contracts. The City may delete or modify any of these standard provisions for a particular Contract by indicating a change in the Special Provisions or in the bid document. Any bidder accepting a purchase order/Contract issued by the City agrees that the provisions included within the Invitation for Bid shall prevail.
28. **Laboratory** Any laboratory as may be designated by the City's Project Manager for the purpose of testing materials and/or Work performed.
29. **Liquidated Damages** The amount prescribed in the Contract documents to be paid to the City by the Contractor, or to be deducted from any payments due to the Contractor, for each calendar day or Working day, whichever is specified in the Contract documents, beyond the stated completion date or any extension thereof. Liquidated damages will represent the agreed damages to the City and shall not be construed as a penalty.
30. **Lump Sum** The total price of a group of items which is priced as a whole.
31. **Materials** All components used in the Work, materials, supplies and equipment incorporated into the Work shall be new, the latest make/model, of the best quality, and the highest-grade Workmanship.
32. **May** Permissive (see Shall).
33. **Modification** Any authorized written order the City's Project Manager issued for a minor change in the Work and shall be synonymous with Field Orders and/or Field Modifications.
34. **Notice to Proceed** Written notice instructing the Contractor to proceed with the Work.
35. **Plans** The drawings, standard plans, profiles, typical cross sections and supplemental drawings which show the dimensions, locations, details, and character of the Work to be performed. All such documents are considered a part of the Contract documents, whether attached to the plans or separate.
36. **Project** The total construction related to the Work provided by this Contract. The Project may include construction by the City or by separate Contractors.
37. **Proposal** The properly signed written (or electronic if authorized) offer of the Bidder to perform all the Work.
38. **Retainage** The amount of monies held by the City until the Contract is successfully completed.

I. DEFINITIONS AND TERMS (Continued)

C. DEFINITIONS (Continued)

- 39. **Right-of-Way** Land, property, or interest therein devoted to or acquired for the purposes of public streets or utilities.
- 40. **Shall** Mandatory. (see May)
- 41. **Special Provisions** Additions to or modifications of the standard specifications and supplemental specifications covering conditions peculiar to the Work.
- 42. **Specifications** Any written requirement for materials, equipment, construction systems, standards or Workmanship for the Work, including performance of related services.
- 43. **Standard Specifications** The officially adopted Standard Specifications City of Lincoln, Nebraska.
- 44. **Subcontractor** An individual, entity, firm, partnership, or corporation to whom the Contractor sublets a portion of the Work.
- 45. **Subsidiary** Any item required in carrying out the duties and obligations imposed by the Contract for which no direct pay will be allowed. The cost of subsidiary items will be included in those items for which payment is proposed.
- 46. **Substantial Completion** shall mean the stage when the City's Project Manager determines (according to the Contract Documents) that the Work or a designated portion thereof is sufficiently complete, and when the Contractor has secured all required occupancy permits, if any, so the City can occupy or use the Work for its intended use.
- 47. **Supplemental Specifications** Specifications adopted subsequent to publication of the standard specifications which may add to, delete, or modify the standard specifications.
- 48. **Surety** The individual, firm, or corporate body bound with and for the Contractor for the acceptable completion of the Work and the Contract, and for payment of all just claims arising there from.
- 49. **Utilities** Overhead or underground wires, pipe lines, conduits, ducts, or structures, sewers or storm sewer drains owned, operated or maintained in or across a public right-of-way or private easement.
- 50. **Work** shall include the construction and services the Contract Documents require, whether completed or partially completed, and all other labor, materials, equipment and services necessary to fulfill the Contractor's obligations. Work may constitute the whole or a part of the Project.

II. PROPOSAL REQUIREMENTS AND CONDITIONS

A. EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OF WORK

Bidders shall inform themselves of the conditions under which the Work is to be performed, concerning the site of the Work, the structure of the ground, obstacles which may be encountered and all other relevant matters concerning the Work to be performed. Where test boring logs and/or reports indicating underground conditions are attached to the Contract Documents, such logs and/or reports shall be considered only for information and as indicative of conditions as observed at the time and place indicated, and the City shall not be held responsible for any variance in conditions encountered at the time of actual construction.

It shall be the responsibility of the Contractor to satisfy himself by such methods as he deems necessary prior to the letting as to underground structures, underground utilities (both public and private), underground soil and rock formations, ground water, and obstacles to be encountered.

The Contractor to whom a Contract is awarded will not be allowed any extra compensation by reason of any matter or thing concerning which he might fully have informed himself prior to the bidding.

The successful Contractor will be required to employ, so far as is possible, such methods and means in the carrying out of his Work as will not cause any interruption or interference with any other Contractor.

The Bidder is expected to base his bid on materials and equipment which comply fully with the plans and specifications, and in the event he names in his bid materials or equipment which do not conform, he will be responsible for furnishing materials and equipment which fully conform at no change in his bid price.

Before submitting a proposal, each Contractor shall examine the complete specifications and plans, including all related documents contained herein.

B. TYING BIDS

Bidders shall not tie their bids to any other proposal except as may be provided in the proposal form or by special provision.

C. QUANTITIES

Bidders shall satisfy themselves as to the correctness of any quantities listed in the proposal form and shall not, after submission of their proposal, dispute such quantities, nor assert that there was any misunderstanding in regard to the nature or amount of Work to be done.

The quantities on projects involving unit prices and materials to be furnished under this Contract are approximate and are to be used only as a basis for estimating the probable cost of the Work and for comparing the proposals. The City may omit portions of the Work, to increase or decrease the quantities as deemed necessary or desirable, and the actual amount of Work to be done and material to be furnished may differ from the estimated quantities, and the basis for payment under this Contract shall be the actual amount of Work and materials done.

II. PROPOSAL REQUIREMENTS AND CONDITIONS (Continued)

D. UNIT PRICES

On a lump sum or partial lump sum Contract where it is anticipated that unforeseeable changes may occur in the construction covered by the lump sum portion of the bid and which will require more or less quantities than are indicated on the Contract plans, the cost of said more or less quantities may be covered by supplemental unit bid prices in the proposal form. The City reserves the right to reject any or all such supplemental unit prices which it deems to be excessive or unreasonable. In the event of such rejection and subsequent need for said more or less Work, the Contract price shall be adjusted by change order in the manner described in these specifications.

In cases where any part or all of the bidding is to be received on a unit price basis, the quantities stated are not intended to govern. The quantities stated, on which unit prices are so invited, are approximate only and each Bidder will be required to make his own estimates of amounts and to calculate his unit price bid accordingly. Bids will be compared on the basis of the stated number of units in the proposal form. Such estimated quantities, while made from the best information available, are approximate only. Payment on the Contract will be based on actual number of units installed on the completed Work

E. ALTERNATIVES

When provided in the proposal form, Bidders may bid on one or more alternatives at his own discretion unless otherwise directed in these specifications or in the Special Provisions.

F. SUBCONTRACTORS

The Contractor shall notify the City's Project Manager in writing of the names and addresses of the Subcontractors he proposes to use on the Contract. The notification shall be submitted prior to the commencement of the subcontracted Work. The City's Project Manager shall have the right to approve or disapprove the use of any Subcontractor. Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor and the City. The Contractor agrees to be fully responsible to the City for the acts or omissions of his Subcontractors and of anyone employed directly or indirectly by him or them and this Contract obligation shall be in addition to the liability imposed by law upon the Contractor.

The Contractor agrees to bind every Subcontractor (and every Subcontractor of a Subcontractor) by the terms of the Contract.

G. CONSTRUCTION PERFORMANCE AND CONSTRUCTION PAYMENT BONDS

Within 10 business days after the acceptance of the bid, the Contractor shall furnish, on a form acceptable to the City, a construction performance and construction payment Bond, in a sum not less than the Contract Sum, executed by the Contractor and by a corporate surety company authorized to transact business in the State of Nebraska. Such Bond shall be conditioned upon the faithful performance of all the terms and conditions of the Contract Documents, including the holding harmless of the City from failure to do so, and including the making good of any and all guarantees that the Contract Documents may require. The Bond shall be further conditioned upon the payment of all laborers and material suppliers used in the performance of the Contract, including Insurance premiums and interest.

II. PROPOSAL REQUIREMENTS AND CONDITIONS (Continued)

H. FAILURE TO EXECUTE THE CONTRACT

It is agreed by the Bidder that upon a failure to enter into the Contract and furnish the necessary Construction Performance and Construction Payment Bond, within 10 business days, the amount of the Bidder's security may, at the discretion of the City, become the property of the City and will be retained, as damages to the City. The award of the Contract may then, at the discretion of the City, be made to the next lowest responsible bidder, or the Work may be rebid, or may be constructed by the City in any legal manner.

III. SCOPE OF WORK

A. INTENT OF DOCUMENTS

The intent of the documents is to include all labor and materials except that which is specifically designated to be supplied by others, all tools and equipment, and everything necessary for the proper execution of the Work. The Contractor shall perform all necessary and incidental Work and furnish any such materials as fully as if they were particularly delineated or described in the Contract.

The Contractor shall bring to the attention of the City's Project Manager any conflicts between various parts of the Contract Documents or questions pertaining to procedures, traffic control or material.

Special Provisions, supplementing or modifying the specifications, whether incorporated in or furnished by addendum to the Contract Documents, shall be considered an integral part of same. Said special provisions shall supersede the specifications.

If the plans and specifications should be found to be contradictory in any part, the specifications shall govern.

Materials or Work described in words which, so applied, have known technical or trade meaning shall be held to refer to such recognized standards.

Figured dimensions on the plans shall be taken as correct but shall be checked by the Contractor before starting construction. Any errors, omissions, or discrepancies shall be brought to the attention of the City's Project Manager and the City's Project Manager's decision thereon shall be final. Correction of errors or omissions on the drawings or specifications may be made by the City's Project Manager when such correction is necessary for the proper execution of the Work.

The City's Project Manager will furnish the Contractor electronic copies of drawings and specifications.

The Contractor may be furnished additional instructions and detail drawings by the City's Project Manager as necessary to carry out the Work required by the Contract Documents. The additional drawings and instructions so supplied shall become a part of the Contract Documents. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

III. SCOPE OF WORK (Continued)

B. EXTRA WORK

In the event portions of such Work are determined by the City's Project Manager to be covered by some of the various items for which there is a bid price or combinations of such items, the remaining portion of such Work will be considered as Extra Work. Extra Work also includes Work specifically designated as Extra Work in the plans or specifications. The Contractor shall do such Extra Work upon receipt of a written order from the City's Project Manager.

Extra Work shall be paid for as determined by the City's Project Manager and shall be on one of the following bases:

1. Unit prices contained in the Contractor's original bid.
2. Supplemental unit prices agreed upon by the City's Project Manager and the Contractor prior to authorization of the change.
3. An agreed lump sum.
4. The actual cost of labor, direct overhead, materials, supplies, equipment and other services required to complete the Work so ordered. In addition, there may be added an amount, to be agreed upon but not to exceed fifteen percent of the actual cost of the Work, to cover the cost of general overhead and profit.
5. If a Subcontractor does the Work, there may be added an amount, to be agreed upon but not to exceed five percent of the Subcontractor's billing, to cover the cost of general overhead and profit.

It shall be expressly understood and hereby agreed to by the Contractor that no claim for Extra Work will be recognized by the City unless same has been authorized in writing by the City's Project Manager and unless claim for such added Work has been filed by the Contractor prior to preparation of the final estimate. The claim should be filed within 14 business days after the need for the Extra Work is recognized.

C. CHANGES IN THE WORK

The City may, at any time as the need arises, order changes in the scope of the Work to be performed or the materials to be furnished without invalidating the Contract. If such changes are minor and have no effect on the amount due or the time required to perform the Work, they may be authorized by the City's Project Manager. The request for such minor changes shall be documented in writing by the City's Project Manager. If such changes require an increase or decrease in the amount due under the Contract or in the time required for performance of the Work, an equitable adjustment shall be authorized by written executed change order.

III. SCOPE OF WORK (Continued)

D. ROCK EXCAVATION

Rock Excavation shall be excavation in solid rock formations in the original bed or well-defined ledges more than 12" in thickness, or detached solid masses of stone more than 1/2 cubic yard in volume which cannot be excavated, loosened or removed by any process other than by drilling or by the use of pneumatic equipment. No soft or disintegrated rock, or rock that has been broken or previously blasted, or broken stone in rock fill or elsewhere, will be classified as rock excavation.

Unless indicated in the proposal, payment will be made for "Rock Excavation" as an Extra Work item.

E. HAUL OR OVERHAUL

Unless specified in the proposal, no payment will be made for "Haul" or "Overhaul." The cost of hauling material to or from the Work regardless of distance shall be considered subsidiary to and a part of the applicable Contract bid price.

F. CLEAN UP

The Contractor shall at all times keep the site of the Work free from accumulations of waste materials or rubbish caused by his employees or Work, and at the completion of the Work he shall remove all rubbish from and about the Work and all tools, equipment, scaffolding and surplus materials and shall leave the site clean and ready for use.

All sewers, conduits, pipes and appurtenances, and all tanks, pump wells, chambers, buildings and other structures shall be kept clean during construction; and as the Work or any part thereof approaches completion, the Contractor shall systematically and thoroughly clean and make any needed repairs to them. He shall furnish, at his own expense, suitable tools and labor for removing all water and cleaning out all dirt, mortar and foreign substances. The City's Project Manager will not approve the final estimate of any portion of the Work until after Final Completion is achieved and the Work found satisfactory. The City may remove or cause the removal of the rubbish, surplus materials, and traffic control devices and deduct the cost from the final estimate or charge the cost to the Contractor if the cleanup is not properly performed by the Contractor within 3 business days of written notice from the City's Project Manager.

G. ACCESS TO THE SITE OF WORK

The Work included in the Contract is in the public right-of-way or easements furnished by the City of Lincoln. The City will guarantee necessary access for the Contractor to carry on the Work of his Contract. The Contractor will be permitted to use only as much of the right-of-way as shall be determined by the City's Project Manager for the Contractor to carry on his Work.

III. SCOPE OF WORK (Continued)

H. OWNERSHIP OF SALVAGED MATERIALS

Materials removed and salvaged in accordance with the plans, or as directed by the City's Project Manager, shall be the property of the City and the Contractor shall load, transport, unload, and neatly stockpile the materials at the location(s) designated in these specifications, in the special provisions, or as directed by the City's Project Manager. Salvaged materials damaged due to the Contractor's negligence will be replaced with new materials at no additional cost to the City or deducted from the final estimate by the City's Project Manager. The Contractor shall furnish salvage receipts to the City's Project Manager if required by these specifications.

I. BORROW AND WASTE SITES

Unless borrow or waste sites are designated on the plans or specified in the special provisions, the Contractor shall be responsible for selecting an appropriate site. These sites shall be maintained by the Contractor at no cost to the City.

IV. CONTROL OF MATERIALS

A. MATERIAL STORAGE

The Contractor shall store all Materials to preserve their quality and fitness for the Work and to facilitate inspection. The Contractor shall store all material under the general supervision and direction of the City's Project Manager. The City's Project Manager, when needed, may order the Contractor to store Materials under cover or on platforms or as the City's Project Manager otherwise reasonably requires to protect the same from damage. Materials from different sources of supply shall not be stored in the same stockpile unless approved by the City's Project Manager.

All storing of equipment and materials shall be within limits of acquired easements or the public right-of-way. The Contractor shall not stage or store any equipment or materials outside of these areas without prior approval by the City's Project Manager. If the Contractor requires additional space outside acquired easements or right-of-way for storage of equipment and material during the duration of the project, then the Contractor, at their expense, shall be responsible to secure temporary property rights from the adjacent property owners and shall provide a copy of the agreement(s) to the City's Project Manager. The Contractor's use of the public right of way for parking equipment or materials storage shall be approved by the City's Project Manager. Temporary placement of equipment and materials in the public right of way shall allow vehicle lines of sight and setbacks to be maintained. Any excavated material shall have required erosion control protection in place until its removal or areas backfilled with cover established. Payment for such erosion control shall be subsidiary to other items.

B. TESTS AND SAMPLES

The Contractor shall furnish, at no expense to the City, such samples of materials as may be required by the City's Project Manager for testing. Materials having the same character, quality, and grading as the approved samples will be acceptable for the particular use for which they are intended. Samples shall be accompanied by a statement giving the type of materials, name of the producer, batch number, date, and location of the plant. The City will provide for the initial testing of materials at no expense to the Contractor. Any expense for retesting required to establish the quality or acceptability of the materials in question shall be borne by the Contractor.

The City reserves the right to retest all materials, prior to incorporation into the Work. The City may then reject all materials that, when retested, do not comply with the Contract Documents.

Sampling and testing of materials shall be done in accordance with the latest version of the "City of Lincoln's QC/QA Materials Sampling Guide" in affect at the time of the contract letting, unless otherwise stipulated in the contract documents or by the City Engineer.

IV. CONTROL OF MATERIALS (Continued)

C. MATERIALS AND WORKMANSHIP

Unless otherwise stipulated in the specifications, all Workmanship, equipment, materials, and articles incorporated in the Work covered by this Contract are to be new and of the best grade of their respective kinds for the purpose. Before placing orders for equipment, the Contractor shall furnish to the City's Project Manager for his approval the name of the manufacturer of machinery, mechanical and other equipment, which he contemplates installing, together with their performance capacities and other pertinent information. If not otherwise provided, the performance called for in this Contract shall be furnished and performed in accordance with well-known established practices and standards recognized by architects, engineers, and the trade. Materials installed or used without approval shall be at the risk of subsequent rejection.

No material of any kind shall be installed in the project until the City's Project Manager verifies the materials are in compliance with the Contract documents. Any materials or Workmanship found at any time to be defective shall be remedied at once regardless of previous inspections.

All materials not conforming to the specifications shall be considered as defective, and all defective material, whether in place or not, shall be rejected, and unless remedied shall be removed from the site of the Work at the Contractor's expense. Rejected material which has been reconditioned or corrected so that it satisfactorily meets the Specifications shall not be used without written approval of the City's Project Manager.

At any time during the course of a project, when, in the opinion of the City's Project Manager, provisions of the Contract documents are being violated by the Contractor or his employees, the City's Project Manager shall have the right and authority to order all construction to cease or material to be removed, until arrangements satisfactory to the City's Project Manager are made by the Contractor for resumption of the Work in compliance with the provisions of the Contract.

D. ALTERATIONS AND SUBSTITUTIONS

The City's Project Manager shall have the right to alter and modify the plans and specifications, thus making specific changes in the Work. If such changes diminish the amount of Work, the Contractor shall not file any claim for anticipated profit from such loss of Work. If such changes increase the amount of Work, such increase shall be made by Modification to the Contract.

Whenever the drawings or specifications identify a materials, article, or piece of equipment by brand name or catalog number, such identification shall define performance, quality level, or other salient requirements. The City's Project Manager may consider other products of equal performance, capacity, quality and function upon the Contractor's written substitution request. Otherwise, the Contractor shall use the identified goods, unless the City's Project Manager approves such request for substitution in writing. Upon any substitution of lesser priced goods, the City's Project Manager shall prepare a Modification deducting any resulting price differential from the Contract Sum. Otherwise, the Contractor shall provide any incidental changes or extra component parts required to accommodate the substitute without a change in the Contract Sum or Contract Time. The Contractor guarantee that approved substitutes will not affect major changes in the function or general design.

IV. CONTROL OF MATERIALS (Continued)

E. MATERIALS SUPPLIED BY THE CITY

Material or equipment furnished by the City for installation by the Contractor will be furnished in good condition and ready for installation. This material or equipment shall be picked up by the Contractor at a location within the City of Lincoln designated by the City's Project Manager.

Excess materials supplied by the City shall be returned by the Contractor to the point of receipt. The Contractor shall be issued a receipt verifying condition and measures of material returned. Materials damaged by the Contractor will not be accepted by the City and the Contractor shall be responsible for the cost or replacement of any such materials.

F. HAZARDOUS ENVIRONMENTAL CONDITIONS

The Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Document to be within the scope of the Work. The Contractor shall be responsible for a Hazardous Environmental Condition created with any materials or equipment brought to the Site by the Contractor, Subcontractors, Suppliers, or anyone else for whom the Contractor is responsible.

If the Contractor encounters a Hazardous Environmental Condition or if the Contractor or anyone for whom the Contractor is responsible creates a Hazardous Environmental Condition, the Contractor shall immediately:

1. Secure or otherwise isolate such condition.
2. Stop all Work in connection with such condition and in any area affected thereby.
3. Notify the City's Project Manager, AND any regulatory agency required by law. The City's Project Manager shall promptly determine the necessity for the City to retain a qualified expert to evaluate such conditions or take corrective action, if any.

The Contractor shall be responsible for any and all civil or criminal penalties, fines, damages, or other charges imposed by any regulatory agency or court for sewage discharges that are in violation of applicable statutes and laws and that are a result, direct or indirect, of Work performed under this Contract. The Contractor shall also be responsible for reimbursement to the City for administration, reporting, and tracking expenses required as a result of any spill event. In the event the regulatory agency or court imposes a probationary period, the Contractor shall post bond for the probationary period to ensure that all such costs are reimbursed to the City. This responsibility shall apply whether penalties are imposed directly on the Contractor or any of its Subcontractors, or the City of Lincoln. The Contractor shall defend and indemnify the City against such penalties. Regulatory agencies may include, but are not limited to, the Department of Environmental Quality and the US EPA.

V. CONTROL OF THE WORK

A. AUTHORITY OF ASSISTANT DIRECTOR OF TRANSPORTATION (CITY ENGINEER)

The City Engineer is empowered to act for the Director of Transportation and Utilities in implementation of **Lincoln Municipal Code 2.35.050 “Supervise Work on Public Property; Enforcement.”**

When the term City Engineer is used in these specifications, only the City Engineer or his/her duly authorized representatives, referred to as the "City Engineer," shall approve any changes or alterations. The list of duly authorized representatives shall be as enacted by Public Work's most current Directorial Order.

B. AUTHORITY OF THE CITY'S PROJECT MANAGER

The City's Project Manager in this Contract is acting as an agent of the City during the construction period. The City's Project Manager shall be the judge of the character, nature and fitness of all work done and materials furnished under this contract, and of the amount, quality, and classification of the several kinds of work for which payment is made. The City's Project Manager shall decide as to the meaning, intent, and performance of this contract. The entire work shall be done to the City's Project Manager's satisfaction. The City's Project Manager shall decide all questions that may arise as to Contract fulfillment on the part of the Contractor and the City's Project Manager's decisions thereon shall be final and conclusive. Such determination shall be a condition precedent to the right of the Contractor to receive any payments hereunder. The City's Project manager shall receive advice regarding fulfillment of the Contract and acceptability of the Work from others including, but not limited to City's Engineering Inspector, Consultants, other City divisions and departments.

The City's Project Manager will have the authority to suspend the Work wholly or in part due to the failure of the Contractor to correct conditions unsafe to the general public; for failure to carry out provisions of the Contract; for failure to carry out orders; for unsuitable weather; for conditions considered unsuitable for the prosecution of the Work; or for any other reason deemed to be in the public interest, for such periods of time as the City's Project Manager deems necessary.

The City's Project Manager shall decide questions, which may arise as to quality and acceptability of materials furnished and Work performed. The City's Project Manager shall hold the Contractor strictly to the intent of the Contract Documents in regard to the quality of materials, Workmanship, and execution of the Work. Inspections may be made at the factory or fabrication plant of the source of material supply.

The City's Project Manager will not be responsible for the construction means, controls, techniques, sequences, or procedures, except that those procedures specifically called for in the Contract Documents shall be strictly followed. The City's Project Manager shall not be deemed authorized to modify, alter, or waive any provisions related to the City Engineer.

V. CONTROL OF THE WORK (Continued)

C. AUTHORITY OF THE CITY'S ENGINEERING INSPECTOR

The City's Engineering Inspector is an appointed agent of the City's Project Manager to inspect all Work done. The City's Engineering Inspector will keep the City's Project Manager informed as to the progress of the Work and the manner in which it is being done. Such inspection may extend to any or all parts of the Work and materials furnished, but the City's Engineering Inspector will not be authorized to revoke, alter, enlarge, or relax the provisions of these specifications. The City's Engineering Inspector is appointed for the benefit of the City and any inspections shall be for the benefit of the City. The presence of the City's Engineering Inspector shall not be used or construed as a waiver of any of the Contractor's obligations pursuant to the Contract. Failure of a City's Engineering Inspector to call the attention of the Contractor to faulty Work or lack of compliance with the plans or specifications shall not constitute acceptance of said Work. Any advice which the Inspector may give the Contractor will in no way be construed as binding the Engineer or City in any nor releasing the Contractor from the fulfillment of the terms of the said Contract. The City's Engineering Inspector shall not be deemed authorized to accept notices or waive any of the provisions hereof or modify any order or orders of said City's Project Manager or City Engineer.

1. The City's Engineering Inspector shall be authorized to:
 - a. Call the Contractor's attention to Work or materials that do not conform to the Contract.
 - b. Reject materials until the City's Project Manager is notified and decides the questions at issue.
2. The City's Engineering Inspector shall not be authorized to:
 - a. Revoke, alter, enlarge, or relax the provisions of the Contract.
 - b. Approve or accept any portion of the completed project.
 - c. Act as foreperson or perform any duties for the Contractor.

D. PRE-CONSTRUCTION AND PROGRESS CONFERENCE

Upon receipt of notification from the City's Project Manager, the Contractor or the Contractor's authorized representative shall, at no cost to the City, appear at a location and time designated by the City's Project Manager for the purpose of discussing pre-construction scheduling, traffic control procedure or methods, and project progress during construction. If a pre-construction open house is scheduled for the project, the Contractor shall attend the pre-construction open house, at no cost to the City, at a location and time designated by the City's Project Manager. The Contractor or the Contractor's authorized representative shall provide, at no cost to the City, any data sheets, construction schedules, or other information deemed necessary by the City's Project Manager.

V. CONTROL OF THE WORK (Continued)

E. PROJECT COORDINATION

Whenever prosecution of Work under the Contract involves coordination and cooperation among various agencies, such as utility companies and other City departments, Subcontractors and other Contractors, the Contractor shall make every effort to coordinate his Work with that of said agencies, in order to minimize any conflicts which may arise and to provide the minimum of inconvenience to all parties involved.

Street reconstruction, excavation, or maintenance work within the parking-metered district, which may involve the use of metered parking stall space, will require that the meter be hooded or removed by the City. The Contractor shall notify the City of Lincoln Urban Development – Parking Services at least 48 hours prior to the time which the parking space or spaces will be occupied.

Prior to any underground work or excavation of any kind, the Contractor shall notify the appropriate agencies and owners, including the One-Call Office, and shall allow personnel access to the site of the Work in order to locate any underground facilities.

The City may require the Contractor to coordinate with other Contractors, Public or Private Entities at or near the Work site. Contractors working in close proximity shall cooperate with each other.

F. INSPECTION TESTING AND CORRECTING WORK

The Contractor shall conduct or arrange for any tests, inspections and approvals of portions of the Work required by the Contract Documents, ordinances, rules, regulations or orders of public authorities having jurisdiction at appropriate times. All testing shall be prompt to avoid unreasonable delay in the Work. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the City, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall secure all required Certificates of testing, inspection or approval unless the Contract Documents require otherwise. The Contractor shall promptly deliver such Certificates to the City's Project Manager.

If the City or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, the City shall instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the City. The City shall bear such costs except as provided in this section. If such testing or inspection, reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the City's services and expenses.

If a portion of the Work has been covered that the City's Project Manager has not specifically requested to observe prior to it's being covered, the City's Project Manager may request to see such Work. Upon such request, the Contractor shall uncover the specified Work. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs. If such Work is in accordance with the Contract Documents, the City shall pay such costs.

V. CONTROL OF THE WORK (Continued)

G. CORRECTING WORK

The Contractor shall promptly correct Work rejected by the City's Project Manager or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear costs of correcting such rejected Work, including additional testing and inspections and compensation for the City's services and expenses made necessary thereby. The Contractor shall remove immediately from the site portions of the Work that are not in accordance with the requirements of the Contract Documents.

If the Contractor fails to correct non-conforming Work within a reasonable time, fixed by written notice from the City's Project Manager, the City may correct it in accordance with the Contract Documents. If the Contractor does not proceed with correction of such non-conforming Work, the City may remove it and store the salvageable materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage within ten business days after written notice the City may sell such materials and equipment at auction or at private sale and shall account for the proceeds thereof, after deducting costs and damages owed by the Contractor, including compensation for the City's Project Manager's services and expenses made necessary thereby. If such proceeds of sale do not cover costs owed by the Contractor, the City shall automatically reduce the Contract Sum by the deficiency. If the remaining Contract amounts are not sufficient to cover such costs, the Contractor shall pay the difference to the City.

The Contractor shall bear the cost of correcting any damages caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents. If there are unremedied damages caused by the Contractor, the City may offset the remaining Contract Sums to cover those damages and/or take any measures allowed by law to remedy the damages.

If the City elects in writing to accept Work that is not in accordance with the requirements of the Contract Documents, the City may do so instead of requiring its removal and correction. Upon such election, the City and the Contractor shall reduce the Contract Sum as appropriate and equitable. The City and the Contractor shall make such adjustment whether or not the City has made final payment under the Contract Documents. The Contractor shall pay the difference, if any, to the City within 10 business days from such adjustment.

H. CONTRACTOR'S USE OF PUBLIC AND PRIVATE UTILITIES

The Contractor will be responsible for arrangements for all temporary service connections for various utilities and is responsible for all necessary payments to the various utility companies for such temporary services. The City may provide a Contractor with a method or process for reimbursement of certain utility payments.

Prior to the use of any City water from a fire hydrant, the Contractor shall take out the necessary permit for a hydrant meter and valve from the Lincoln Water System.

The Contractor shall pay the permit fees which are established by the Lincoln Water System for the installation or moving of hydrant meters and valves.

The Contractor shall not operate the hydrant, but shall use the exterior valve to control the flow of water. The Contractor shall be liable for any damage to the meter and valve.

V. CONTROL OF THE WORK (Continued)

I. SHOP DRAWINGS

The Contractor, as soon as possible, shall submit to the City's Project Manager all shop or other drawings and schedules required for the Work, including those pertaining to structural and reinforcing steel. The need for more than one resubmittal or any other delay in obtaining the City's Project Manager's review of submittals will not entitle the Contractor to an extension of the Contract time. The Contractor shall make any corrections in the drawings required by the City's Project Manager and resubmit the same without delay. Catalog sheets or other descriptive data shall be furnished on all equipment to be installed. Such material shall be in sufficient detail to accurately describe the materials and method of operation of the equipment.

The Contractor shall submit shop drawings in a format approved by the City to City's Project Manager who, after checking, will retain a copy and return a reviewed document to the Contractor. The City's Project Manager's approval of shop drawings of equipment and material shall extend only to determining the conformity of such equipment and materials with the general features of the design drawings prepared by the City's Project Manager. It shall be the responsibility of the Contractor to determine the correctness of all dimensions and minor details of such equipment and materials so that, when incorporated in the Work, correct operation will result. Approval by the City's Project Manager will not relieve the Contractor of any responsibility for the proper performance or functioning of the completed project.

The Contractor shall obtain the City's Project Manager's approval before beginning any portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals.

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC

A. PROTECTION FROM LOSS

The Contractor shall protect all parts of the Work from loss by theft or otherwise, and shall assume all risks for repair and replacement for damage to the same, whether caused by lightning, fire, wind, water, theft, vandalism, or other causes, until completion and acceptance of the Work.

B. ASSUMPTION OF LIABILITY AND INDEMNIFICATION

The Contractor shall indemnify, defend and save harmless the City of Lincoln, Nebraska from and against all losses, claims, damages, and expenses, including attorney's fees, arising out of or resulting from the performance of the Contract that results in bodily injury, sickness, disease, death, or injury to or destruction of tangible property, including the loss of use resulting there from and is caused in whole or in part by the Contractor, any Subcontractor, any directly or indirectly employed by any of them or anyone for whose acts any of them may be liable. This section will not require the Contractor to indemnify or hold harmless the City of Lincoln for any losses, claims, damages, and expenses arising out of or resulting from the sole negligence of the City of Lincoln, Nebraska.

C. CONTRACTOR'S INSURANCE

The Contractor shall not commence Work under this Contract until he has obtained all insurance required under this article or as may be required elsewhere in the Contract Documents, until such insurance has been approved by the City. The Contractor shall not allow any Subcontractor to commence Work on his subcontract until all similar insurance required of the Subcontractor has been so obtained with the amount specified in the Contract Document.

D. PATENTED DEVICES, MATERIALS, AND PROCESSES

It is mutually understood and agreed that, without exception, Contract prices are to include all royalties and costs arising from patents, trademarks, and copyrights in any way involved in the Work. It is the intent that whenever the Contractor is required or desires to use any design device, material, or process covered by letters, patent, or copyright, the right for such use shall be provided for by legal agreement with the patentee or owner, however, whether or not such an agreement is made as noted, the Contractor and the surety in all cases shall indemnify, defend and save harmless the City from any and all claims for infringement by reason of the use of any such patented design, device, material, or process, or any trademark or copyright, in connection with the Work agreed to be performed under the Contract, and shall indemnify the City for any costs, expenses, and damages which it may be obligated to pay, by reason of any such infringement, at any time during the prosecution or after the completion of the Work.

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC (Continued)

E. INDEPENDENT CONTRACTORS

The City is interested only in the results obtained and the Contractor shall perform as an independent Contractor with the sole control of the manner and means of performing the Work required under the Contract. The Contractor shall complete the Contract according to its own means and methods of Work, which shall be in the exclusive charge and control of the Contractor and which shall not be subject to control or supervision by the City except as to the results of the Work. The Contractor is, for all purposes arising out of the Contract, an independent Contractor, and the Contractor or any Subcontractor, agent, employee or representative and employees or agents of any of them shall not be deemed an employee of the City.

It is expressly understood and agreed that the Contractor shall in no manner be entitled to any benefits to which the City's employees are entitled including, but not limited to, overtime, any retirement benefits, Workers' compensation benefits and injury leave, or other benefits.

F. PROTECTION OF WORK, PROPERTY, AND PERSONS

The Contractor shall protect and support all water, sewer, gas and other pipes and structures; telephones, cable, fiber optic or electric power lines; all railroad tracks, pavement, building walls, fences, utilities, sprinkler systems, or other properties, public or private, which may be damaged during the execution of this Work. During all operations under the Contract, the Contractor shall carefully protect all trees, shrubbery, sod, plantings, etc., not designated to be removed as part of the Work of the Contract, and he shall assume full responsibility for their damage or destruction.

Where necessary, the Contractor may have to hand dig around trees to prevent damage to tree roots. Contractor shall protect all trees within the project area. Any form of protection chosen by the Contractor, such as fences, ropes, etc., shall be furnished, erected, and maintained by the Contractor and be subsidiary to other bid items. Any trees that appear to have significant root damage caused by excavation or any tree that needs trimmed in or from the public right-of-way, shall be coordinated with the Project Manager or their representative who shall contact the City Forestry Section to verify any necessary actions in saving, trimming, or removing the damaged tree.

Contractor shall also protect existing street surfaces, trails/sidewalks, curbs and public right-of-way areas that are used for staging/storing equipment, completing construction or used for equipment access at their own expense. The Contractor shall determine their own means and methods of protecting the streets, sidewalks, driveways, curbs, public right-of-way, etc. In all circumstances, absolutely no indentations, gouges, ruts, or other damage to asphalt or concrete surfaces greater than 1/8 inch shall be permitted. The Contractor shall be responsible for repair or replacement of any damaged street surfaces, sidewalks, driveways, etc. that are to remain in place at their own expense, to the City's Project Manager's satisfaction. Heavy equipment shall not be used on sidewalks or over potential areaways.

In the event of any damage or injury to any property as a result of the Work under this Contract, the Contractor shall promptly have the same repaired at his expense to the satisfaction of the City's Project Manager. If there are unremedied damages to public property caused by the Contractor, the City may offset the remaining Contract Sums to cover those damages and/or take any measures allowed by law to remedy the damages. He shall take all reasonable and proper precautions to protect persons, and property from injury, and any damage. The Contractor must keep fire hydrants and inlets free from unnecessary encumbrance.

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC (Continued)

F. PROTECTION OF WORK, PROPERTY, AND PERSONS (Continued)

Existing sub-surface structures in the vicinity of the Work to be done are shown on the plans in accordance with the best information available to the City. The City does not, however, guarantee the completeness or accuracy of this information. Any delay or extra cost to the Contractor due to encountering structures differing from those shown on the plans shall not constitute a claim for extra payment. The location of house sewer connections, water services, underground sprinklers and gas services are not definitely known and no attempt is made, therefore, to indicate such connections and services on the plans.

G. COMPLIANCE WITH LAWS

The Contractor and his employees shall comply with all Federal, State and local laws and regulations, and shall require all Subcontractors and all their employees likewise to comply.

H. FAIR EMPLOYMENT PRACTICES

The Contractor and the Subcontractors shall not discriminate against any employee or applicant for employment, to be employed in the performance of the Contract, with respect to his hire, tenure, terms, conditions, or privileges of employment, because of race, color, religion, sex, disability, age, ancestry, marital status or national origin, pursuant to the requirements of Section 48-1122, Nebraska Reissue Revised Statutes and Section 48 as amended.

I. FAIR LABOR STANDARDS

The Contractor and the Subcontractors shall maintain Fair Labor Standards in the performance of the Contract, as required by Nebraska Revised Statutes § 73-102 through 104 as amended.

J. EQUAL EMPLOYMENT AND LIVING WAGE

Each bidder shall comply with the requirements of Lincoln Municipal Code Title 11, Equal Opportunity, in the performance of the Work under the Contract. Failure of the successful bidder to abide by the requirements during the Contract period shall be deemed to be a substantial and willful violation of the requirements of the Contract Documents, and may result in termination of the Contract.

This Contract is subject to the Living Wage Ordinance of the Lincoln Municipal Code. The Ordinance requires that, unless specific exemptions apply or a waiver is granted, all employers (as defined) under service Contracts shall provide payment of a minimum living wage to employees. Such rate shall be adjusted annually pursuant to the terms of the Lincoln Living Wage Ordinance of the Lincoln Municipal Code.

Under the provisions of the Lincoln Living Wage Ordinance, the City shall have the authority, under appropriate circumstances, to terminate this Contract and to seek other remedies as set forth therein, for violations of the Ordinance.

K. UNEMPLOYMENT CONTRIBUTION

The Contractor and Subcontractors shall pay to the Unemployment Fund of the State of Nebraska unemployment contributions and interest due under the provisions of Section 48-601 through 48-671, Nebraska Reissue Revised Statutes of 1943, on wages paid to individuals employed in the performance of the Contract.

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC (Continued)

L. ASSIGNMENT OF CONTRACTS

No assignment by the Contractor of any Contract, or any part thereof, or of the funds to be received there under by the Contractor, will be recognized unless such assignment has had the written approval of the Mayor and the Surety has been given due notice of such assignment and has furnished written consent thereto.

Such written approval by the Mayor shall not relieve the Contractor of the obligations incurred by him under the terms of this Contract. In addition to the usual recitals in assignment Contracts, the following language must be set forth:

"It is agreed that the funds to be paid to the assignee under this assignment are subject to a prior lien for services rendered or materials supplied for the performance of the Work called for in said Contract in favor of all persons, firms, or corporations rendering such services or supplying such materials."

M. PERMITS AND LICENSES

Permits and licenses necessary for prosecution of the Work shall be secured and paid for by the Contractor unless otherwise stated. Permits, licenses, easements (both permanent and temporary), and rights-of-way of a permanent nature shall be secured and paid for by the City. The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work as drawn and specified. If the Contractor observes that the Contract Documents are in variance with any laws, ordinance, rules or regulations, he shall promptly notify the City's Project Manager in writing and any necessary changes shall be accomplished as provided in these specifications.

N. PAYMENT OF BILLS

The Contractor shall pay and shall indemnify and save harmless the City for all labor, materials, equipment, and supplies actually used or rented in the performance of the Work, including all insurance premiums on insurance required by the Contract Documents, and shall furnish to the City, when required, satisfactory evidence that all persons, firms, or organizations who have done Work or furnished materials, equipment, or supplies in the performance of the Work, or have provided any such required insurance, have been fully paid or satisfactorily secured. In case such evidence is not furnished, an amount necessary or sufficient shall be retained from any amounts which may be due the Contractor to meet the claims of the persons, firms, or organizations aforesaid, in addition to any other monies which are to be retained as otherwise specified in the Contract Documents, until the liabilities aforesaid shall be fully discharged or satisfactorily secured.

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC (Continued)

O. STANDARD MANUFACTURER

Wherever the terms "standard," "recognized," or "reputable" manufacturer are used, they shall be construed as meaning manufacturers who have been engaged in the business of fabricating materials, equipment, or supplies of the nature called for by the specifications for a reasonable period of time prior to the date set for opening bids, and who can demonstrate to the satisfaction of the City's Project Manager that said manufacturer has successfully installed equipment, materials, or supplies of the type proposed to be furnished in at least three instances, and that the performance of such materials, equipment, or supplies has been satisfactory. Manufacturers who have been engaged in the business of manufacturing said materials, equipment, or supplies for a period of over 12 months prior to the date fixed for opening bids shall, prima facie, be deemed to have been engaged in such business for a reasonable length of time.

P. "OR EQUAL" CLAUSE

Whenever, in any section of the Contract Documents, plans, or specifications, any article, material, or equipment is defined by describing a proprietary product, or by using the name of a manufacturer or vendor, the term "or approved equal," if not inserted, shall be implied. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency, and quality desired, and shall not be construed in such a manner as to exclude manufacturer's products of comparable quality, design, and efficiency. The City shall determine the acceptability of articles, materials, or equipment proposed as equals.

Q. SANITARY CONVENIENCES

The Contractor shall supply and maintain adequate sanitary facilities by providing temporary and portable units on the Work site to comply with current City-County Health Department and State Department of Health requirements and regulations. These facilities are to be made available for the Contractor's employees and project personnel. No direct payment shall be made for this Work, but it shall be considered subsidiary to other items of Work for which direct payment is made.

R. EXECUTIVE ORDERS/PRIVATE CONSTRUCTION AGREEMENTS

Any Work to be performed within the limits of, crossing over, or intended to occupy the public right-of-way shall be guided and governed by these standard specifications and general conditions. The Director of Transportation and Utilities reserves the right to approve or disapprove any such Work performed within the public right-of-way, even though, as in the case of certain Executive Orders or Private Construction Agreements, the City is not a party to the Contract. While the City may not actually be party to the Contract, this fact shall not in any way relieve the Contractor from wholly satisfying all the standards and conditions set forth in these specifications.

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC (Continued)

S. PURCHASING AGENT APPOINTMENT AND EXEMPT SALES CERTIFICATE

The Contractor performing the Work for the City of Lincoln, Nebraska, except for Work performed for the Lincoln Water System, will be issued a Purchasing Agent Appointment and Exempt Sales Certificate signed by the Purchasing Agent of the City. It is to be used by the Contractor and his Subcontractors when purchasing tangible personal property to be actually incorporated into the Contract Work, including materials incidental but necessary to the performance of the Contract, provided that such materials are actually incorporated into the Contract Work. It does not apply to either (1) the purchase of materials to be used but not incorporated into the Contract Work, including but not limited to form lumber, scaffolding, etc., or (2) the purchase or rental of machinery, equipment, or tools owned or leased by the Contractor or his Subcontractors and used in performing the Contract Work.

Purchases qualifying as aforesaid shall be considered as being made by the City. The City shall be obligated to the vendor for the purchase price, but the Contractor or Subcontractor, as the case may be, shall handle all payments therefore on behalf of the City. The vendor shall agree to make demand or claim for payment of the purchase price from the City by submitting an invoice to the Contractor or Subcontractor. Title to all materials and supplies so qualifying shall vest in the City directly from the vendor. Regardless of the method of payment, title shall vest immediately in the City. The Contractor or Subcontractor shall not acquire title to any materials incorporated into the project. All invoices shall bear the Contractor's or Subcontractor's name as agent for the City.

The Contractor may reproduce copies of this Contract Agreement and of the original of the aforesaid Appointment and Certificate to furnish to his suppliers on each invoice or order. The Contractor shall enter the supplier's (the vendor's) name and address, the date, the invoice or order number, a description of the items, and the amount, in the spaces provided and shall sign the certificate on the line provided for the "Purchaser's Agent."

The Contractor shall provide each Subcontractor with a copy of this Contract Agreement and of said Appointment and Certificate, and on each Subcontractor's copy of said Appointment and Certificate the Contractor shall add the Subcontractor's name and address in the places provided therefore. Each Subcontractor is hereby given the authority to reproduce copies of the copy of said Appointment and Certificate thus provided him by the Contractor and to furnish the same to his (the Subcontractor's) suppliers on each invoice or order; and the Subcontractor shall complete and sign the same for his purchases in like manner as above set forth for the Contractor.

Any portion of this project used for providing water service, such as pipe and fittings for water mains, is subject to sales and use taxes. The remainder of this project is exempt from sales and use taxes.

No one shall issue the Purchasing Agent Appointment (PAA) certificate forms except the Purchasing Agent. When the contractor requests these forms they need to inform the Purchasing Agent what materials they are buying and for which project (identify with project description and number).

VI. LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC (Continued)

T. WEED CONTROL

During the construction of the project the Contractor shall control all vegetation so as to comply with City regulations. The areas to be controlled are the public rights-of-way within the project limits and the easements acquired for the construction or any areas (so designated on plans or specifications) as deemed necessary by the City's Project Manager.

No direct payment shall be made for this Work, but it shall be considered subsidiary to other items of Work for which direct payment is made.

U. SNOW REMOVAL

During the construction of the project, the City's Project Manager will advise the Contractor of the level of maintenance that shall be required during construction. The Contractor shall be responsible for snow removal and any material spreading that may be needed to provide safe access to the residences or businesses within the limits of the project. The Contractor shall notify the Engineer regarding the manpower, equipment and material necessary to attain that level of maintenance. Payment shall be made for this work as Extra Work.

V. AUDIT BOARD

The Contractor shall be subject to audit pursuant to Chapter 4.66 of the Lincoln Municipal Code and shall make available to a contract auditor, as defined therein, copies of all financial and performance related records and materials germane to the contract/order, as allowed by law.

W. E-VERIFY

In accordance with Neb. Rev. Stat. 4-108 through 4-114, the contractor agrees to register with and use a federal immigration verification system, to determine the work eligibility status of new employees performing services within the state of Nebraska. A federal immigration verification system means the electronic verification of the work authorization program of the Illegal Immigration Reform and Immigration Responsibility Act of 1996, 8 U.S.C. 1324 a, otherwise known as the E-Verify Program, or an equivalent federal program designated by the United States Department of Homeland Security or other federal agency authorized to verify the work eligibility status of a newly hired employee pursuant to the Immigration Reform and Control Act of 1986. The Contractor shall not discriminate against any employee or applicant for employment to be employed in the performance of this section pursuant to the requirements of state law and 8 U.S.C.A 1324b. The contractor shall require any subcontractor to comply with the provisions of this section.

VII. PROSECUTION AND PROGRESS OF WORK

A. NOTIFICATION

The Contractor shall keep the City's Project Manager informed, a minimum of 48 hours in advance, of the times and places at which he intends to Work in order that inspections may be arranged, lines and grades may be furnished, detours established if needed, and necessary measurements made with the minimum of inconvenience to the City's Project Manager and delay to the Contractor.

Notice of intention to start Work in a new location or to resume Work on a job which has been suspended temporarily for any reason must be given to the City's Project Manager at least 48 hours in advance unless otherwise approved by the City's Project Manager.

For any Work that requires construction within the public right-of-way, 48 hours advance notice shall be given to the City's Project Manager. For any Work that requires closing of any portion of a street, permission shall be obtained from the City Engineer, thru the City's Project Manager.

Any Work done without proper notification or without being properly located and established by base lines, offset stakes, bench marks, or other basic reference points, may be ordered removed and replaced at the Contractor's expense.

B. COMMENCEMENT

The Work under the Contract shall begin after the date stated in the written Notice to Proceed. Such Work shall be completed and accepted within the limit and before the final completion date stated in the Contract Agreement.

The Contractor shall begin the Work at such locations and proceed with the Work conforming to such schedules as may be approved by the City's Project Manager. The Work and the determination, count and reporting of calendar days or working days shall commence on the Beginning of Work date as determined by the City's Project Manager.

The period of time between Notice to Proceed and Beginning the Work shall not be counted toward the contract time for work associated with, but not limited to, shop drawings and submittals, materials procurement, preconstruction meetings and work outside the limits of the project. Contractor may submit a written request to the City's Project Manager to exclude environmental commitments from the contract time allowance if Work such as netting of bridges, topping of trees, or other Work associated with environmental commitments is necessary prior to the Beginning of Work dates.

C. DELAYS

The Contractor shall not be entitled to any claims against the City for damages for hindrances or delays, from any cause whatsoever, in the progress of the Work or any portion thereof.

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

D. SUPERVISION AND DISCIPLINE BY CONTRACTOR

The Contractor shall supervise and direct the Work using their best skill and attention. The Contractor shall be solely responsible for and shall have control over construction means, methods, techniques, sequences, coordination, and procedures for all portions of the Work.

The Contractor shall be responsible to the City for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under a Contract with the Contractor.

E. WINTER CONSTRUCTION - SUSPENSION OF WORK

Suspension of Work for the winter period is due to general unsuitable weather, conditions unsuitable for prosecution of the Work, and other reasons that are in the public interest. Suspension of Work for the winter period is not automatic and shall be requested by the Contractor.

The winter period shall be considered from December 1st to March 15th for Utility Work.

The winter period shall be considered from November 1st to April 1st for Paving Work.

1. Suspension of Work during the winter construction period may be requested by the Contractor. The request must be made in writing to the City's Project Manager and shall include the beginning date and duration. If Work is to be resumed prior to expiration of time requested, 48 hours written notice of such intent will be required.
2. The Contractor shall be required to restore all vehicular and pedestrian facilities to full use by either permanent or temporary restoration before the suspension period will become effective.
3. Prior to suspension the City's Project Manager will advise the Contractor of the level of maintenance that shall be required during suspension. The Contractor shall be responsible for snow removal and any material spreading that may be needed to provide safe access to the residences or businesses within the limits of the project. The Contractor shall notify the City's Project Manager regarding the manpower, equipment and material necessary to attain that level of maintenance. Payment shall be made for this work as Extra Work.
4. The City's Project Manager shall state to the Contractor, in writing, the effective suspension date and the date on which the suspension expires and the new adjusted completion date. Calendar Days included in the period that Work is actually suspended shall be counted from the effective suspension date, and the governing completion date shall be adjusted accordingly. In no case shall a granted suspension of Work be cause for requesting or granting additional Calendar Days for completion of this Contract.

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

F. EXTENSION OF TIME

The time for completion of the Work may be extended upon written request from the Contractor to the City's Project Manager, provided the request is based on delays or suspensions that are no fault of the Contractor; and such delays shall include, but not be limited to, acts or neglects of the City or others performing additional Work, site conditions not under the control of the Contractor, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God. The length of such extension, if approval is recommended by the City's Project Manager, shall be the equivalent number of Working days, if the Contract time is expressed in Working days, or the equivalent number of Calendar Days, if the Contract time is expressed in Calendar Days or is expressed as a specific completion date, during which the Work was suspended, or in proportion to the amount of Extra Work compared to the amount of the original Contract. Requests for extensions in completion dates shall be made within 20 business days of occurrence.

Certain delays will not be justified for extension of time. Such delays, shall include, but not limited to:

1. Delays caused by a Subcontractor.
2. Inadequate construction force.
3. Failure to place orders for equipment or materials in a timely manner.
4. Normal periods of adverse weather.
5. Subsurface or otherwise concealed subsurface conditions which are not unusual.

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

G. LIQUIDATED DAMAGES

If the Contractor fails to complete the Work in a timely manner, according to the Contract (allowing for any approved extensions of time), the Contractor shall pay Liquidated Damages for each day that the Work remains incomplete. The City shall deduct the amount of Liquidated Damages due from the money due the Contractor prior to final payment. If the remaining amount due the Contractor is less than the total amount of Liquidated Damages, the Contractor shall pay the difference within 10 business days. If the Contractor fails to pay such difference, the City shall have the right to recover the difference from the Contractor or his Surety.

Unless specifically amended or modified by special provision, the daily amount of the Liquidated Damages shall be as follows:

1. Contract Sum up to and including \$100,000: \$300/day
2. Contract Sum more than \$100,000 up to and including \$500,000: \$500/day
3. Contract Sum more than \$500,000 up to and including \$1,000,000: \$750/day
4. Contract Sum more than \$1,000,000: \$1,000/day

The Liquidated Damages provided herein are not considered punitive. The Contractor agrees that such damages are predetermined and reasonable amounts to compensate for the detriment to the public and to defray expenses incurred by the City due to the delay in the completion of the Work.

H. TERMINATION FOR CAUSE

1. The City may terminate the Contract if the Contractor:
 - a. Refuses or fails to supply enough properly skilled Workers or proper materials;
 - b. Fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
 - c. Disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or
 - d. Otherwise commits a substantial breach of any provision of the Contract Documents.
2. When any of the above reasons exist, the City without prejudice to any other rights or remedies of the City may (after giving the Contractor and the Contractor's surety, if any, 7 business days' written notice) terminate employment of the Contractor. In addition, the City may (subject to any prior rights of the surety):
 - a. Take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
 - b. Accept assignment of subcontracts; and
 - c. Finish the Work by whatever reasonable method the City may deem expedient.

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

H. TERMINATION FOR CAUSE (Continued)

3. If the Contract is terminated by the City as provided in this section, the Contractor shall not be entitled to receive any further payment until the expiration of 35 business days after Final Completion and acceptance of all Work by the City.

If the unpaid balance of the Contract Sum exceeds the cost of completing the Work, including all additional costs and expenses made necessary thereby, including costs for City staff time, plus all losses sustained, including any liquidated damages provided under the Contract Documents, such excess shall be paid to the Contractor. If such costs, expenses, losses, and liquidated damages exceed the unpaid balance of the Contract Sum, the Contractor shall pay such excess to the City.

If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination has been issued for the convenience of the City.

No termination or action taken by the City after termination shall prejudice any other rights or remedies of the City provided by law or by the Contract Documents upon such termination; and the City may proceed against the Contractor to recover all losses suffered by the City.

I. TERMINATION BY THE CITY FOR CONVENIENCE

1. The City may at its option, terminate this Contract in whole or in part at any time without cause by written notice thereof to the Contractor.

Upon any such termination, the Contractor agrees to waive any claims for damages, including loss of anticipated profits, on account thereof, and as the sole right and remedy of the Contractor, the City shall pay the Contractor in accordance with this Paragraph. The provisions of the Contract which by their nature survive final acceptance of the Work, shall remain in full force and effect after such termination to the extent provided in such provisions.

Upon receipt of any such notice of termination, the Contractor shall, unless the Notice directs otherwise, immediately:

- a. Discontinue the Work to the extent specified by the City;
- b. Place no further orders or subcontracts for materials, equipment, services or facilities, except as may be necessary for completion of that portion of the Work, if any, the City has directed not to be discontinued;
- c. Promptly make every reasonable effort to procure cancellation upon satisfactory terms as determined by the City of all orders and subcontracts not related to that portion of the Work, if any, the City has directed not to be discontinued;

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

I. TERMINATION BY THE CITY FOR CONVENIENCE (Continued)

- d. Do only such other activity as may be necessary to preserve and protect Work already in progress and to protect materials and plants and equipment on the Project Site or in transit thereto.

Upon such termination, the obligations of the Contract shall continue as to portions of the Work already performed and as to bona fide obligations the Contractor assumed prior to the date of termination.

Upon termination, the City shall pay the Contractor the full cost of all Work properly done by the Contractor to the date of termination not previously paid for by the City. If at the date of such termination the Contractor has properly prepared or fabricated off site any goods for subsequent incorporation in the Work, the City may direct the Contractor to deliver such goods to the Site or to such other place as the City may reasonably determine, whereupon the City shall pay to the Contractor the cost for such goods and materials.

2. Upon such termination, the City shall pay to the Contractor the sum of the following:
 - a. The amount of the Contract Sum allocable to the portion of the Work properly performed by the Contractor as of the date of termination, less sums previously paid to the Contractor.
 - b. Previously unpaid costs of any items delivered to the Project site which was fabricated for subsequent incorporation in the Work.
 - c. Any proven losses with respect to materials and equipment directly resulting from such termination.
 - d. Reasonable demobilization costs.

The above payment shall be the sole and exclusive remedy to which the Contractor is entitled in the event of termination of the Contract by the City pursuant to this provision; and the Contractor will be entitled to no other compensation or damages and expressly waives same.

J. CLAIMS & DISPUTES

The Contractor and the City shall make any Claim against the other party in writing giving a description thereof. The claimant may make a Claim only within 21 calendar days after occurrence of the event giving rise to such Claim or within 21 calendar days after the Claimant first recognizes the condition giving rise to the Claim, whichever is later.

Pending final resolution of a Claim (unless the Parties otherwise agree in writing) the Contractor shall proceed diligently with performance of the Contract and the City shall continue to make payments in accordance with the Contract Documents.

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

J. CLAIMS & DISPUTES (Continued)

When the City makes final payment and the Contractor accepts the same, the City and the Contractor thereby waive all claims except those arising from:

1. Unsettled liens, Claims, security interests or encumbrances arising out of the Contract;
2. Failure of the Work to comply with the requirements of the Contract Documents; or
3. Terms of special guarantees required by the Contract Documents.

If either party encounters or discovers (1) subsurface or otherwise concealed physical conditions which differ materially from the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherently encountered in the Work, then the observing party shall give prompt notice of the condition to the City's Project Manager and the other party by giving a description thereof. The observing party shall give such notice promptly before conditions are disturbed and in no event later than 21 calendar days after first observance of the same.

If the Contractor wishes to make Claim for an increase in the Contract Sum, the Contractor shall provide written notice as provided herein before proceeding to execute the Work. Written notice is not necessary for emergencies endangering life or property. The Contractor may make claims for additional cost for reasons including but not limited to (1) a written opinion from the City's Project Manager, (2) an order by the City to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the City's Project Manager, (4) failure of payment by the City, (5) termination of the Contract by the City, (6) City's suspension or (7) other reasonable grounds.

If the Contractor wishes to make Claim for an increase in the Contract Time, the Contractor shall give written notice as provided herein. The Contractor's Claim shall include an estimate of cost and delay on the Work, if any. In the case of a continuing delay only one Claim is necessary.

If the Contractor bases a Claim for additional time on adverse weather, the Contractor shall substantiate such Claim with data substantiating that: (1) the adverse weather was abnormal for the period of time, (2) the Contractor could not have reasonably anticipated the adverse weather, and (3) the weather had an adverse effect on the scheduled construction.

If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, the claimant shall give written notice of such injury or damage (whether or not insured) to the other party within 21 calendar days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If the claimant asserts additional cost or time related to such injury or damage, the claimant shall file a separate claim for each.

VII. PROSECUTION AND PROGRESS OF WORK (Continued)

K. RESOLUTION OF CLAIMS AND DISPUTES

The City's Project Manager shall review Claims and take one or more of the following preliminary actions within 10 business days after receipt of a Claim: (1) request additional supporting data from the Claimant, (2) submit a schedule to the parties indicating when the City's Project Manager expects to take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The City's Project Manager may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

If the City and the Contractor resolve the Claim, the City's Project Manager shall prepare a Change Order or other documentation accordingly.

If the City and the Contractor do not resolve the Claim after consideration of the foregoing, either party may seek a judicial resolution of any Claim. Any Claim against the City shall comply with the provisions of *Neb. Rev. Stat.* § 15-840 et seq. and other applicable laws relating to claims against the City.

VIII. GUARANTEE AND PAYMENT

A. GUARANTEE

These guarantees shall not limit the City's rights with respect to latent defects, gross mistakes, or fraud.

1. All Work

Unless specified otherwise in the Contract Documents, the Contractor shall guarantee the Work for a period of one year after: Final Completion of the Work or a designated portion thereof. Nothing contained in this paragraph shall establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents.

2. Utility Construction

The Contractor guarantees all utility construction, against defects in material or Workmanship for a period of 2 years from the date of the approval and acceptance by the proper authority of the Work performed under the Contract Documents; and he also guarantees against damage, during the 2 year guarantee period, structures, all backfilled trenches and all sidewalks, pavement, and driveways judged by the City's Project Manager to have been a part of, in close proximity to, or built subsequent to the Work performed under the Contract Documents. The Contractor guarantees all traffic and non-owner supplied street lighting materials for 2 years from the date of approval and acceptance. The Contractor shall bear the entire expense and cost of all repairs, which may from imperfection in Work or material, become necessary within that time.

3. Asphaltic Paving and Resurfacing

The Contractor guarantees all paving construction against defects in material or Workmanship for a period of 2 years from the date of the approval and acceptance of the Work performed under the Contract Documents. The Contractor shall bear the entire expense and cost of repairing any surface cracks that develop in the asphalt surface within such guarantee period. The cracks shall be carefully cleaned of foreign material and filled with emulsified asphalt crack filler or asphalt cement. All of this Work shall be performed at the direction and to the satisfaction of the City's Project Manager.

4. Portland Cement Concrete (PCC) Pavement

The Contractor guarantees all paving construction against defects in materials or Workmanship for a period of 2 years from the date of the approval and acceptance of the Work performed under the Contract Documents.

The Contractor shall bear the entire expense and cost of repairing any random surface cracks or spalling that develops in the finished slab. The cracks shall be routed and filled with a joint sealer meeting the requirement as specified in Chapter 4 of these Standard Specifications. The Contractor shall reseal all transverse and longitudinal joints that are showing signs of any separation. All such joints shall be resealed with the same product that the Contract required, or a similar substitute as approved by the City's Project Manager.

VIII. GUARANTEE AND PAYMENT (Continued)

A. GUARANTEE (Continued)

5. Procedure

If at any time within the period of guarantee, any of the Work included in the guarantee shall require any repair or reconstruction, the City's Project Manager shall notify the Contractor to make the repairs required. Upon receipt of such notice, the Contractor shall proceed with such repairs and shall complete the same within a time fixed by the City's Project Manager, all at the Contractor's cost and expense.

If the Contractor shall neglect or fail to proceed with such repairs, then the City shall have the right to cause such repairs to be made in such manner as it deems best and the whole cost thereof shall be paid directly by the Contractor or reimbursed by him to the City; and if the Contractor neglects or refuses to do so, such cost shall be paid by the Contractor's Surety on the performance bond required by the Contract Documents. The liability of such bond shall continue during the full guarantee period.

It shall be the duty of the Contractor to notify the City's Project Manager in writing within 30 calendar days prior to the expiration of the guarantee period to make a final inspection of the Work. If the Contractor does not furnish such notice, the obligation to maintain such Work in proper condition shall continue in force until such notice shall have been issued as above provided. If the end of the guarantee period falls between December 1st and April 30th, then such period may not be considered as expired until May 1st following, and the 30 days' notice must be served upon the City's Project Manager the month preceding that date.

B. SUBSTANTIAL COMPLETION

When the Contractor considers that the Work (or a portion thereof that the City agrees to accept separately) is substantially complete, the Contractor shall prepare and submit to the City's Project Manager a comprehensive list of items to be completed or corrected. The Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Upon receipt of the Contractor's list, the City's Project Manager shall make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the City's Project Manager's inspection discloses any item that does not comply with the Contract Documents (including any items on the Contractor's list) the Contractor shall complete or correct such item upon the City's Project Manager's written notification. Once corrected or completed, the Contractor may submit a request to the City's Project Manager for another inspection to determine Substantial Completion.

VIII. GUARANTEE AND PAYMENT (Continued)

B. SUBSTANTIAL COMPLETION (Continued)

When the Work or designated portion thereof is substantially complete, the City's Project Manager may prepare a Certificate of Substantial Completion. Upon the City's approval, such Certificate shall establish: (1) the date of Substantial Completion; (2) responsibilities of the Contractor for security, maintenance, heat, utilities, damage to the Work and Insurance; and (3) the time for the Contractor to finish all items on the list accompanying the Certificate.

Guarantees provided in the Contract Documents shall commence on the date of Substantial Completion unless otherwise provided in the Certificate of Substantial Completion. The Contractor shall accept the Certificate of Substantial Completion and the responsibilities assigned in such certificate by signing the same. The City's Project Manager shall submit the Certificate to the Contractor for such acceptance.

The City shall make payment for the Work as certified in the Certificate of Substantial Completion upon the Contractor's written application and the City's Project Manager's Certificate for payment as provided in the Contract Documents.

The Contractor shall secure and deliver to the City any written guarantees from Subcontractors, Sub-Subcontractors and suppliers. Such guarantees shall state the period of guarantee as required by the Contract Documents or otherwise as the City has agreed. The Contractor guarantees all of the Work regardless of separate guarantees by Subcontractors at any tier.

C. ACCEPTANCE OF WORK

All Work shall be deemed as having been fulfilled and met when the Work is accepted by the City by formal action of the City's Project Manager that the Work be finally accepted. Upon acceptance of the Work by the City, ownership of the Work shall pass to the City.

No Work shall be accepted until the City's Project Manager has completed the final inspection and notified the Contractor of satisfactory completion of same; if any areas of concern for Workmanship or materials exist at the time of final inspection, the City's Project Manager shall notify the Contractor, in writing, of remaining deficiencies.

The Contractor shall correct all deficiencies. No Work shall be accepted until the final completion of the whole; and inspection during construction or partial payment for Work or materials shall not imply any acceptance of same.

D. PROGRESS PAYMENT

Providing the Work herein contracted for is being performed in accordance with the provisions of the Contract Documents, the City's Project Manager may make an approximate estimate of the value of the Work performed during the previous month. After each estimate has been approved by the City, the City may then pay to the Contractor, in City warrants, 95% of the value of the Work completed to date. The City may, at all times, reserve and retain out of said payment all such sums as, in the judgment of the City's Project Manager, will be adequate to insure completion of the Work. Retainage amounts may be reduced with the written request of the Contractor and agreement by the City's Project Manager in advance of project completion. Consideration will be given to time frames of Work completion in relationship to the total Work.

VIII. GUARANTEE AND PAYMENT (Continued)

D. PROGRESS PAYMENT (Continued)

The City may include in progress payments the invoiced value of materials on hand and properly stored and to be used solely on the contracted project, so long as the unit bid price is not exceeded.

The Contractor may request semi-monthly progress payments. Such requests shall be made in writing to the City's Project Manager.

If the City's Project Manager certifies the project is substantially complete and provided a final payment will be delayed more than 60 calendar days because of project complexities or the determination of final costs and quantities, the City's Project Manager may authorize payment in an amount not to exceed 99% of the value of the Work performed.

E. FINAL PAYMENT

1. Lump Sum Contracts.

The City's Project Manager shall, as soon as practicable after the completion and final acceptance of the Work, make a final payment for the amount of Work done under the Contract Documents. Final payment shall be determined and executed by change order or by executive order.

2. Unit Price Contract.

When all the Work under the Contract Documents is completed and accepted, the City's Project Manager shall determine the final quantities of the various items of Work performed. He shall have prepared a final estimate of the total amount due the Contractor, which estimate shall be based on the final quantities and Contract unit prices, together with the value of any extra Work. Final payment shall be determined and executed by change order or executive order.

3. All Contracts.

When the final payment has been approved by the City, the City will pay to the Contractor, all amounts accruing under the Contract Documents, less authorized adjustments to reflect properly the amount of Work done less liquidated damages and less all previous progress payments. All prior estimates shall be subject to correction in the final estimate and payment.

4. Waiver of Claims.

The making and acceptance of final payment shall constitute:

- a. A waiver of all claims by the City against the Contractor other than those arising from defective Work appearing after the final inspection or from failure to comply with the requirements of the Contract documents or the terms of any special guarantees specified therein, and
- b. A waiver of all claims by the Contractor against the City.

IX. MISCELLANEOUS

A. AUDIT/EXAMINATION OF RECORDS

Whenever the City enters into any type of contractual arrangement, the Contractor's records shall, upon reasonable notice, be open to inspection and subject to audit and/or reproduction during normal business Working hours. Such audits may be performed by a City's representative or an outside representative engaged by the City. The City or its designee may conduct such audits or inspections throughout the term of this Contract and for a period of five years after final payment.

The Contractor's records, as referred to in this Contract, shall include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may, in the City's judgment, have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records shall include (hard copy, as well as computer readable data if it can be made available), written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, etc.); original estimates; estimating Work sheets; correspondence; change order files (including documentation covering negotiated settlements); back charge logs and supporting documentation; invoices and related payment documentation; general ledger entries detailing cash and trade discounts earned, insurance rebates and dividends; and any other Contractor records which may have a bearing on matters of interest to the City in connection with the Contractor's dealings with the City (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of:

1. Contractor compliance with Contract requirements,
2. Compliance with ethical practices, and
3. Compliance with provisions for pricing change orders, invoices or claims submitted by the Contractor or any of his payees.

The Contractor shall require all payees (examples of payees include Subcontractors and material suppliers) to comply with the provisions of this article by including the requirements hereof in a written Contract agreement between the Contractor and payee. Such requirements to include flow-down right of audit provisions in Contracts with payees will also apply to Subcontractors and Subcontractors' material suppliers, etc. The Contractor will cooperate fully and will cause all related parties and all of the Contractor's Subcontractors (including those entering into lump sum subcontracts) to cooperate fully in furnishing or in making available to the City from time to time whenever requested, in an expeditious manner, any and all such information, materials and data.

The City's authorized representative or designee shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this Contract, and shall be provided adequate and appropriate Work space, in order to conduct audits in compliance with this article.

If an audit inspection or examination in accordance with this article discloses overpricing or overcharges (of any nature) by the Contractor to the City in excess of 1% of the total Contract billings, in addition to making adjustments for the overcharges, the reasonable actual cost of the City's audit shall be reimbursed to the City by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time, not to exceed 90 calendar days from presentation of the City's findings to Contractor.

IX. MISCELLANEOUS (Continued)

B. CONTRACTOR GUARANTEES REGARDING SCHEDULING

The Contractor covenants and guarantees that the Contractor will not:

1. Misrepresent to the City its planning, scheduling and coordination of the Work;
2. Utilize schedules materially different from those given to or made available to the City or any Subcontractors for the direction, execution and coordination of the Work, or which are not feasible or realistic;
3. Prepare schedules, updates, revisions or reports which do not accurately reflect the Contractor's actual intent or the Contractor's reasonable and actual expectations as to:
 - a. The sequences of activities;
 - b. The duration of activities;
 - c. The responsibility for activities;
 - d. Resource availability;
 - e. Labor availability or efficiency;
 - f. Expected geological conditions;
 - g. Weather, strikes or other delays or events impacting the Work;
 - h. Value associated with the activity;
 - i. The percentage complete of any activity;
 - j. Completion of any item of Work or activity;
 - k. Project Completion;
 - l. Delays, slippages or problems encountered or expected;
 - m. Subcontractor requests for time extension, or delay claims of Subcontractors.
4. The Contractor's failure to comply with the foregoing covenant and guarantee shall be a substantial and material breach of Contract which will permit the City to terminate the Contractor for default, or withhold payments under the Contract Documents, and shall entitle the City to the remedies and damages afforded for misrepresentation or fraud by these Contract Documents or applicable law.
5. Should the Contractor fail to comply with the provisions of the Contract Documents relating to scheduling and execution of the Work by the overall project schedule, the City shall have the right, at its option, to retain the services of scheduling consultants or experts (including attorneys if necessary in the opinion of the City) to prepare schedules, reports, updates and revisions of the schedule in accordance with the Contract Documents and to review and analyze same, in order to allow the City and the City's Project Manager to evaluate the progress of the Work by the Contractor to determine: a) whether the Contractor is complying with the Contract Documents, and to direct such action of the part of the Contractor, as permitted by the Contract Documents, as required to ensure, under the City's schedule prepared hereunder, that the Contractor will complete the Work within the Contract Time; and b) all costs and expenses and fees incurred by the City in preparing the schedule hereunder shall be charged to the Contractor's account. If the Contractor fails to comply with the scheduling and execution of the Work requirements of the Contract Documents, the Contractor hereby agrees, in such instance, to comply with such City-prepared schedules, if any, or directions and activity sequences, and durations as the City may reasonably require, without additional cost to the City (subject only to cost adjustments for such changes in the Work as the City may direct) to ensure completion within the Contract Time.

X. INSURANCE REQUIREMENTS

A. WAIVERS OF SUBROGATION

The City and the Contractor waive all rights against (1) each other and any of their Subcontractors, sub-Subcontractors, agents and employees, each of the other, and (2) the Consultant, separate Contractors, if any, and any of their Subcontractors, sub-Subcontractors, agents and employees, for damages caused by fire or other perils to the extent covered by property Insurance obtained pursuant to this Section X or other property Insurance applicable to the Work, except such rights as they have to proceeds of such Insurance held by the City as fiduciary. The City or the Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate Contractors, if any, and the Subcontractor, sub-Subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers for Subrogation by endorsement or otherwise. A waiver of Subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the Insurance premium direct or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

B. INSURANCE REQUIREMENTS FOR ALL CITY CONTRACTS

To obtain the current Insurance requirements for all City Contracts, go to the City's website at:

<http://www.lincoln.ne.gov/city/finance/purch/index.htm>

The duties and obligations imposed by these General Provisions and the right and remedies available hereunder, and, in particular but without limitation, the guarantees and obligations imposed upon the Contractor and the rights and remedies available to the City hereunder shall be in addition to, and shall not be construed in any way as a limitation of, any rights and remedies available to them which are otherwise imposed or available by law, by special guarantee or by other provisions of the Contract documents.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

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CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 1

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CHAPTER 1

GENERAL MISCELLANEOUS ITEMS

This chapter will cover items of a general and/or miscellaneous nature. The items may be related to multiple chapters or multiple types of Work.

1.00 MOBILIZATION

A. GENERAL

This Work shall consist of preparatory Work and operations, associated with the necessary movement of personnel, equipment, supplies and incidentals to the project site and for all the Work and operations which must be performed or costs that are necessarily incurred prior to commencing the Work. The Contractor shall include all expected costs for movement of his and any Subcontractors' equipment and material necessary to prosecute the Work to completion, including any demobilization. Additional payments will not be made for interruptions in the prosecution of the Project if the Contractor fails to adequately assess the actual costs of mobilization.

B. BASIS OF PAYMENT

No measurement is required. 50% of the bid item for mobilization will be paid with the initial pay estimate. The balance of the bid item for mobilization will be paid when 20% of the value of the Work has been completed. The bid amount for mobilization cannot exceed 10% of the total bid amount (including mobilization).

1.01 CONSTRUCTION STAKING

A. GENERAL

The City will provide horizontal and vertical control points as shown on the plans for the Contractor's use in establishing the exact location and elevations for the project. The Contractor shall be responsible for preserving (or re-establishing) these control points if necessary. The Contractor shall use this control to provide all construction staking that is required for the project. This shall include staking for grading, pavement construction, utility construction, retaining walls, establishment of temporary easement limits and right-of-way lines, and all other survey Work to complete the project in conformance with the details shown on the plans. The Contractor shall follow the current Lincoln Standard Plans for staking information.

The Contractor shall be responsible for the placement and preservation of adequate ties and references necessary to complete the Work. Any additional stakes, templates and other materials necessary for marking and maintaining all reference points and lines shall be the responsibility of the Contractor. The Contractor shall be solely and completely responsible for the accuracy of the line and grade for all features of the Work. All Work shall be completed to the lines, grades, and elevations indicated on the plans. The Contractor shall remove and reconstruct, at his expense, Work that is improperly located.

Construction staking shall be certified by a Registered Land Surveyor in the State of Nebraska. Staking records shall be recorded in a format approved by the City and submitted to the City at the completion of the project. This Work shall be considered subsidiary to "CONSTRUCTION STAKING."

1.01 CONSTRUCTION STAKING (Continued)

B. BASIS OF PAYMENT

Construction staking shall not be measured, but shall be paid at the Contract price bid for Lump Sum for the pay item "CONSTRUCTION STAKING." The amount of the lump sum to be included in each partial payment shall be in proportion to the value of the Work completed with respect to the total amount of the original bid. Such payment shall be full compensation for furnishing all labor, equipment, tools, materials, recording and incidental items necessary to complete the Work.

1.02 SURVEY MONUMENTS AND MONUMENTS BOXES

A. GENERAL

This section includes preservation of existing survey monuments and benchmarks, as well as the installation of new survey monuments and benchmarks. In the case of any existing permanent monuments or bench marks which out of necessity must be removed or disturbed in the construction of the Work, the Contractor shall carefully protect and preserve the same until they can be properly referenced for relocation under the direction of a Registered Land Surveyor in the State of Nebraska, and in case of damage or destruction, Contractor will be charged with the expense of their replacement.

B. MATERIALS

All materials used in the fabrication of Monument Boxes shall meet the requirements of "Specifications for Gray Iron Castings," ASTM Designation A-48, Class 30. They shall conform in all respects to the designs for such castings as shown on the Standard Plans. All frames and covers shall be machined so that each cover will fit properly in its frame with no rocking. No casting will be accepted that is warped, cracked, that has welds, or that has been plugged or filled. Monument pins shall be 3/4" round steel bars at least 2' in length.

When the monument location falls outside of pavement, the monument box may be omitted at the City's Project Manager's discretion.

C. INSTALLATION

The Contractor shall install survey monument boxes and monuments at all points shown on the plans. In general, new monuments shall be located for the centerline of right-of-way at every intersection, not centerline of street pavement, including placing point-of-curvature and point-of-tangency where there is a curve in the right-of-way. All monument boxes shall be placed after the paving is complete. Monument boxes installed in paving shall be placed by use of a concrete coring machine equipped with a 7" O.D. bit.

All monument locations shall be established under the direction of a Registered Land Surveyor in the State of Nebraska. The Surveyor is required to prepare and file a Survey Record Drawing in conformance with Nebraska State statutes.

1.02 SURVEY MONUMENTS AND MONUMENTS BOXES (Continued)

D. BASIS OF PAYMENT

Monument boxes and survey monuments placed in conformance with these Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for SURVEY MONUMENT AND BOX. Such payment shall be full compensation for furnishing all labor, equipment, tools, materials, recording and incidental items necessary to complete the Work.

1.03 PROPERTY PIN ESTABLISHMENT

A. GENERAL

The Contractor shall have a Registered Land Surveyor establish property pins for those lots where Right-of-Way boundaries have changed, property pins were removed by the project, or two or more feet of fill was placed over the property pin, as approved by the City's Project Manager. The property pins shall be established under the direction of a Registered Land Surveyor in the State of Nebraska and the Surveyor is required to prepare and file a Survey Record Drawing in conformance with Nebraska State statutes.

B. BASIS OF PAYMENT

Property pins placed in conformance with these Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for PROPERTY PIN ESTABLISHMENT. Such payment shall be full compensation for furnishing all labor, equipment, tools, materials, recording and incidental items necessary to complete the Work.

1.04 PAVEMENT AND SIDEWALK REMOVAL

This Work shall include the removing of existing pavement, surface and base courses, concrete headers, combination curb and gutter, concrete curb, concrete gutter, concrete driveways, walks, steps, retaining walls, and miscellaneous masonry, as required; and shall also include salvaging and disposing of the resulting material, together with the necessary excavation and backfilling.

A. GENERAL

The City's Project Manager shall identify all areas of authorized pavement removal. The removal of existing pavement shall extend to an existing joint, or to the limits shown on the plans. When called for on the plans or by the City's Project Manager, all pavement to be removed shall be isolated from the pavement to remain by cutting a saw joint, as provided below, or by other methods specifically approved by the City's Project Manager. The pavement to be removed shall be broken into movable sizes and removed from the site. If the pavement to remain is damaged by the Contractor, the City's Project Manager will order further removal at the Contractor's expense. Pavement which is removed without authorization by the City's Project Manager shall be replaced at the Contractor's expense.

The Contractor shall coordinate with the City's Project Manager prior to removal of pedestrian ramps at all signalized intersections to ensure that lowering of the pedestrian ramp will not result in excessive exposure of signal pole foundations.

B. BASIS OF PAYMENT

When called for in the proposal, pavement, sidewalk, driveway, curb, steps, retaining wall and miscellaneous masonry items removed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per cubic yard for PAVEMENT AND SIDEWALK REMOVAL. The quantity shall be determined based on surface measurement and average depth of the removal. Such payment shall be full compensation for removal, loading, hauling, disposal of all materials, all equipment, tools, labor, and incidentals necessary to completely remove the said items from the job site.

1.05 TYPE 'A' SAWING

A. GENERAL

Asphaltic Concrete pavement to be removed shall be isolated from the pavement to remain by cutting a joint with a wheel saw, through the full depth of the pavement. After the pavement base has been replaced, a 4" wide strip of the asphaltic concrete surface course shall be sawed and removed to provide a straight, smooth edge where the new asphaltic surfacing adjoins the existing surfacing.

B. BASIS OF PAYMENT

When called for in the proposal, sawing Asphaltic Concrete with a wheel saw, completed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for TYPE 'A' SAWING. Such payment shall be full compensation for all Work associated with isolating the pavement to be removed and removing the 4" strip of asphalt, including all equipment, tools, labor, and incidentals necessary to complete this type of Work.

1.06 TYPE 'B' SAWING

A. GENERAL

Portland Cement Concrete (PCC) pavement to be removed shall be isolated from the paving to remain by cutting a full depth saw cut, using either a wheel saw or diamond blade. If a wheel saw is used, additional sawing shall be required to provide smooth, straight and true vertical faces.

B. CONCRETE SLURRY

The Contractor shall immediately and continuously remove the slurry or residue from the saw cut operation. The Contractor shall not permit slurry to flow across shoulders or lanes occupied by traffic. The Contractor shall not permit slurry or residue into gutters, inlets, or other drainage facilities. The Contractor shall leave slabs clean and dry with no residue remaining upon completion of sawing operations, with the exception of residue or slurry into excavations or subgrade that doesn't drain to gutters, inlets, or other drainage facilities.

C. BASIS OF PAYMENT

When called for in the proposal, sawing Portland Cement Concrete (PCC) pavement, completed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for TYPE 'B' SAWING. Such payment shall be full compensation for all Work associated with isolating the pavement to be removed, cleaning of slabs and removal of slurry or residue, equipment, tools, labor, materials, and incidentals necessary to complete this item of Work.

1.07 TYPE 'C' SAWING

A. GENERAL

Portland Cement Concrete (PCC) driveways and sidewalks to be removed shall be isolated from the driveway and sidewalk to remain by cutting a full depth saw cut.

B. CONCRETE SLURRY

The Contractor shall immediately and continuously remove the slurry or residue from the saw cut operation. The Contractor shall not permit slurry to flow across shoulders or lanes occupied by traffic. The Contractor shall not permit slurry or residue into gutters, inlets, or other drainage facilities. The Contractor shall leave slabs clean and dry with no residue remaining upon completion of sawing operations, with the exception of residue or slurry into excavations or subgrade that doesn't drain to gutters, inlets, or other drainage facilities.

C. BASIS OF PAYMENT

When called for in the proposal, sawing Portland Cement Concrete (PCC) driveways and sidewalks, completed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for TYPE 'C' SAWING. Such payment shall be full compensation for all Work associated with isolating the pavement to be removed, cleaning of slabs and removal of slurry or residue, equipment, tools, labor, materials, and incidentals necessary to complete this item of Work.

1.08 TYPE 'D' SAWING

A. GENERAL

Asphaltic Concrete Surface Course to be removed from concrete base shall be sawed and removed to provide a straight, smooth edge where the new asphaltic surfacing will adjoin the existing.

B. BASIS OF PAYMENT

When called for in the proposal, sawing Asphaltic Concrete Surface Course, completed in conformance with the Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for TYPE 'D' SAWING. Such payment shall be full compensation for all Work associated with isolating the surfacing to be removed, including all equipment, tools, labor, materials, and incidentals necessary to complete this item of Work.

1.09 WHEEL SAWING

A. GENERAL

Pavement to be removed shall be isolated from the pavement to remain by cutting a joint with a wheel saw, through the full depth of the pavement.

B. CONCRETE SLURRY

The Contractor shall immediately and continuously remove the slurry or residue from the saw cut operation. The Contractor shall not permit slurry to flow across shoulders or lanes occupied by traffic. The Contractor shall not permit slurry or residue into gutters, inlets, or other drainage facilities. The Contractor shall leave slabs clean and dry with no residue remaining upon completion of sawing operations, with the exception of residue or slurry into excavations or subgrade that doesn't drain to gutters, inlets, or other drainage facilities.

C. BASIS OF PAYMENT

When called for in the proposal, sawing pavement with a wheel saw, completed in conformance with the Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for WHEEL SAWING. Such payment shall be full compensation for all Work associated with isolating the pavement to be removed, cleaning of slabs and removal of slurry or residue, equipment, tools, labor, materials, and incidentals necessary to complete this item of Work.

1.10 MAIL BOXES

Mail boxes which conflict with construction or are located on a street which is being paved shall be removed by the Contractor and set in a temporary location designated by the City's Project Manager. At the completion of construction, the Contractor shall reset all mail boxes as nearly as possible to their original locations and in conformance with Postal Regulations. The condition of the mail boxes shall be equal to their original condition or shall be replaced by the Contractor at the Contractor's expense. Mail boxes which are ornamental in nature or which, in the opinion of the City's Project Manager, cannot be temporarily relocated shall be delivered to the mailbox owner.

Removal, relocation, and resetting of mail boxes or storage and resetting of mail boxes, completed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall not be measured and paid for separately. Such cost shall be considered a part of the unit prices for which direct payment is made.

1.11 MANHOLES

A. GENERAL

The adjustment of existing manholes to grade shall include furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the Work of adjusting the manhole cast iron ring and cover to an elevation as determined by the City's Project Manager.

When adjusting manholes in streets, the ring and cover shall be no lower than 3/8" below finish street elevation. If it is determined a manhole does not meet this requirement, the Contractor will be required to use the City's Typical Utility Adjustment Detail as shown in LSP 61 at no cost to the City.

B. BASIS OF PAYMENT

Manholes adjusted to grade in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be counted and paid for at the contract unit price bid per each for ADJUST MANHOLE TO GRADE. Such payment shall be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the Work.

1.12 INLETS

A. GENERAL

The adjustment of existing inlets to grade shall include furnishing all materials, labor, equipment, tools and incidentals necessary to complete the Work of adjusting the inlet top including the ring and cover to an elevation as directed by the City's Project Manager.

B. BASIS OF PAYMENT

Inlets adjusted to grade in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be counted and paid for at the contract unit price bid per each for ADJUST INLET TO GRADE or ADJUST GRATE INLET TO GRADE. Such payment shall be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the Work.

1.13 WATER VALVE BOXES AND WATER STOP BOXES

A. GENERAL

The adjustment of existing water valve boxes and water stop boxes shall include furnishing all labor, equipment, tools and incidentals necessary to complete the Work of adjusting the water valve box or water stop box to an elevation as determined by the City's Project Manager.

When adjusting valve boxes in streets, the cover shall be no lower than 3/8" below finish street elevation. If it is determined a valve box does not meet this requirement, the Contractor will be required to use the City's Typical Utility Adjustment Detail as shown in LSP 61 at no cost to the City.

B. BASIS OF PAYMENT

Water valve and stop boxes adjusted to grade in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for ADJUST WATER VALVE BOX TO GRADE or ADJUST WATER STOP BOX TO GRADE. Such payment shall be full compensation for all equipment, tools, labor, and incidentals necessary to complete the Work. Stop boxes and valve boxes broken by the Contractor's operations shall be replaced at the Contractor's expense. Boxes broken by other than the Contractor's operations or obsolete boxes shall be replaced and paid for as an Extra Work item.

1.14 CONSTRUCTION OVER NEW SEWERS

Where pavements are being constructed over newly constructed sanitary sewers within the thirty (30) day period, the Contractor shall request TV inspection by the Lincoln Wastewater System for the reaches of sewer that may affect subgrade preparation. The Contractor shall notify the Department at least forty-eight (48) hours in advance of any paving operations. Failure to notify the Department will not exempt Contractor from repairing defective pavement which needs to be replaced as a result of sewer repair activities. There will be no TV inspection costs billed to the Contractor for TV inspection that meets these conditions.

1.15 CULVERT REMOVAL

Driveway and street culverts shall be removed and stored at a location on the project site designated by the City's Project Manager. Culverts which are not claimed by the respective property owners and which have a salvage value, as determined by the City's Project Manager, shall be loaded onto City trucks. Those culverts which have no salvage value shall be removed from the project site by the Contractor.

Culvert removal, loading, salvage, storage, or disposal shall be considered subsidiary to the cost of Work for which direct payment is made.

1.16 KEYHOLE POTHOLE EXCAVATION AND BACKFILL

A. GENERAL

This specification covers the requirements for keyhole coring, vacuum excavation, backfilling, and reinstatement of the keyhole core in asphalt or concrete pavements to allow for underground utility repairs and underground potholing. Quality control field inspection and testing requirements including frequency shall be in conformance with Contracting Agency requirements.

Keyhole coring is the operation of coring a circular hole through the street pavement using diamond core drilling equipment.

B. MATERIALS

The material and placement requirements in the pipe zone and final backfill area shall be in conformance with Chapter 20 of these Lincoln Standard Specifications. Pavement keyhole cores removed shall either be removed from the work site or stored in a safe and secure on-site location. The cores shall be made readily available for restoring the pavement after backfilling is complete and approved.

The bonding agent shall be a single component cementitious, rapid hardening, high strength waterproof bonding agent conforming to the physical properties shown in Table 1. The bonding material shall be impervious to water penetration at the joint after application. The bonding materials shall securely bond the undamaged keyhole core to the pavement and shall completely fill the annular space at the joint. The bonding materials shall within 30 minutes at an ambient temperature of 70° F. allow the core to support an equivalent traffic load condition of at least 3 times the AASHTO H-25 standard. The bonding material shall be Utilibond, manufactured by Utilicor Technologies Inc., or Engineer approved equal.

TABLE 1 – BONDING MATERIAL PROPERTIES

Property	ASTM Test method	Requirements
Bond Strength (Slant Shear), psi (70° F., 30-minute cure)	C882	200 minimum
Strength, psi (70° F., 60-minute cure)	C109	1500 minimum

1.16 KEYHOLE POTHOLE EXCAVATION AND BACKFILL (Continued)

C. POTHOLE EXCAVATION

The vertical alignment of the keyhole coring shall be perpendicular to the horizon, and the cutting shall extend to the full depth of the existing pavement section. No keyhole cores shall be drilled within 2' of an existing contraction, construction, or control joint. Full depth patches shall be used in these areas. No keyhole cores shall be drilled within the approach pavement of a bridge or box culvert structures. Unless otherwise approved by the City's Project Manager, keyhole cores shall not be greater than 24" in diameter. Adjacent cores shall not be closer than 3' from each other (edge to edge), shall not contain a joint or any pavement cracks greater than 1/8" wide, and shall not be performed in pavements where the section is less than 6" thick. In the event of a misaligned keyhole with the underground facility, a second overlapping core may be drilled provided there is at least 1/3 overlap and BOTH cores are drilled consecutively. This method is not applicable to existing restored cores that may be present in the surface. If the second keyhole is also misaligned, then a conventional full depth patch will be required for restoration. Coring shall be performed with a keyhole coring saw. The contractor shall place a temporary mark on the keyhole core prior to cutting to ensure that the removed section is replaced in the same orientation as originally found in the pavement. Soils within potholes shall be removed by air/hydro-excavation methods to expose utilities. The zone of soil removal shall remain essentially within a vertical plane extending below the edges of the removed pavement. The Contractor shall remove all unsuitable materials from the site.

D. POTHOLE BACKFILL AND COMPACTION

The backfilling of each zone shall be completed in conformance with Chapter 20 of these Standard Specifications unless otherwise approved by the City's Project Manager. In lieu of compacted soil backfill the contractor may elect to use, with City's Project Manager's approval, Flowable Fill, Coarse Aggregate, Fine Aggregate, or approved equal meeting City of Lincoln Specifications. Pneumatic compaction equipment (pneumatic rammers or equivalent) shall be used for compaction of the backfill material. The size of the compactor shall not exceed 2/3 of the diameter of the cored keyhole. Jetting or hydro-flushing of the backfill shall not be permitted. Care shall be taken to ensure that the utility is properly bedded with material of an approved density or in conformance with these Standard Specifications. The initial 12" of backfill above the top of the pipe shall be carefully placed to protect the pipe bedding from further backfilling operations. Backfill shall be mechanically compacted to a minimum density of 95% of the maximum dry density of the material as determined by AASHTO Method T-99. The moisture content of the soils shall be between 2% below and 4% above the optimum moisture content as determined by the above test.

1.16 KEYHOLE POTHOLE EXCAVATION AND BACKFILL (Continued)

E. PAVEMENT RESTORATION

The surface cut by keyhole coring restored to its original condition with the reinstated core flush with and in the original orientation as the existing surface matching existing pavement surface appearance. Excess bonding material shall be removed from the restored surface. A patched appearance shall be avoided in surface restoration wherever possible. Unless otherwise approved by the City's Project Manager, the Contractor shall reinstate the bonded keyhole core within 24 hours of cutting the pavement. Openings within public access or openings allowed to be left open greater than 24 hours shall be covered with a steel street plate capable of supporting traffic loads without movement or racking.

1. Surface Tolerances

The reinstated core shall be flush and level with the adjacent pavement. Gaps attributable to the positioning of the core shall be less than 1/16" between the bottom of a minimum 3' long straight edge and the surface of the pavement in any direction of the surface of the keyhole core.

F. DEFICIENCIES

Where the keyhole core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstatement, the core shall not be used to restore the pavement. A keyhole core shall be considered unacceptable when the keyhole core contains any vertical cracks wider than 1/8" extending full depth through the core; or any deteriorated piece of the keyhole core is larger than 10% of the overall area of the core; or 2 or more successive layers of pavement in the keyhole core become horizontally delaminated and cannot be re-bonded to each other with the bonding material.

All keyhole cores that are damaged or do not meet the surface tolerances shall be removed and disposed of off-site. The pavement at damaged keyhole core locations shall have a permanent full-depth patch installed by the Contractor in conformance with the City of Lincoln Standard Specifications and Standard Plans including but not limited to: LSP 642 and LSP 670.

G. BASIS OF PAYMENT

Unless otherwise specified, the quantity of Keyhole Pothole Excavation and Backfill will not be measured for payment but shall be considered incidental to other items of work for which direct payment is being made.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 2

EARTHWORK

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CHAPTER 2

EARTHWORK

2.00 GENERAL

Earthwork shall include all necessary clearing, grubbing, stripping and excavation within the limits of the Work. Earthwork shall include but not be limited to removal of obstructions, removal and disposal of unsuitable materials and debris, borrow, excavation, construction of fills and embankments, park spacing, ditch excavation and any other item of Work necessary to conform to these Standard Specifications, and to conform to the line, grade and cross section shown on the plans, or as directed by the City's Project Manager.

2.01 GENERAL CLEARING AND GRUBBING

A. GENERAL

The necessary removal of all trees and stumps less than 12" in diameter, brush, roots, shrubs, trash, etc. within the limits of the project shall be as directed by the City's Project Manager. The debris removed shall be disposed of at an appropriate, off-site location. No burning will be allowed at the site of the Work.

Roots 2" in diameter or greater shall be removed to a depth of at least 12" below natural ground, subgrade, or finish grade elevation as directed by the City's Project Manager.

B. BASIS OF PAYMENT

General clearing and grubbing shall not be measured and paid for directly. The cost of this Work shall be considered subsidiary to other items of Work for which direct payment is made.

When called for in the proposal, clearing and grubbing shall not be measured, but shall be paid for at the contract unit price bid as a lump sum for GENERAL CLEARING AND GRUBBING. Such payment shall be full compensation for all tree and stump removal, removal of brush, roots, shrubs, trash, fencing which is not to be replaced, and for all materials, equipment, tools, labor and incidentals necessary to complete the Work in conformance with these Standard Specifications and accepted by the City's Project Manager.

2.02 TREE REMOVAL

A. GENERAL

Trees 12" in diameter or greater measured 24" above the ground shall be removed from the site of the Work together with their stumps and roots 2" in diameter or greater. Existing stumps and stumps resulting from tree removal, together with roots 2" in diameter or greater shall be removed to a depth of at least 12" below natural ground, subgrade or finished grade. The resultant organic material shall be removed from the job site and the remaining hole shall be filled and compacted in conformance with these Standard Specifications.

B. BASIS OF PAYMENT

Trees 12" in diameter and larger and their stumps, removed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per each for TREE REMOVAL _____" to _____" for the various sizes called for.

2.02 TREE REMOVAL (Continued)

B. BASIS OF PAYMENT (Continued)

Such payment shall be full compensation for the removal of the tree and its stump, backfilling, disposal of organic matter, materials, equipment, tools, labor, and incidentals necessary to complete the Work.

Existing stumps 12" in diameter and larger, removed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per each for STUMP REMOVAL _____" to _____" for the various sizes called for. Such payment shall be full compensation for removal of the stump, backfilling, disposal of organic matter, materials, equipment, tools, labor and incidentals necessary to complete the Work.

2.03 TRANSPLANT TREE (SAPLINGS TO 6")

A. GENERAL

Trees to be transplanted, as shown on the plans, shall be moved to their new locations using truck or tractor mounted equipment designed to perform such Work. The equipment to be used and method shall be approved by the City's Project Manager prior to performing such Work. When the new location is not shown on the plans, the tree shall be transplanted to a location on the job site as designated by the City's Project Manager.

Transplanted trees shall be staked and wired to provide support and maintain the tree in a vertical position for a minimum of one full growing season.

B. BASIS OF PAYMENT

Trees which are transplanted in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid each for TRANSPLANT TREE (SAPLINGS TO 6"). Such payment shall be full compensation for transplanting the tree, backfilling, supporting the tree, materials, tools, labor and incidentals necessary to complete the Work.

2.04 REMOVE & RESET FENCE

A. GENERAL

Where indicated on the plans or in the Special Provisions, fences to be removed and reset shall be removed by the Contractor, stockpiled during construction, and reconstructed in their original location or at locations indicated. The Contractor shall use all salvageable materials for resetting the fence whenever possible. When the material is not reusable, the Contractor shall supply new materials in order to restore the fence to at least its original condition.

B. BASIS OF PAYMENT

Fence removed and reset using new or salvaged material, constructed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per linear foot for REMOVE AND RESET FENCE. Such payment shall be full compensation for all removal, excavation, stockpiling, reconstruction, new materials when required, equipment, tools, labor and incidentals necessary to remove and replace the fence.

2.05 EXCAVATION

A. GENERAL

All suitable material obtained from excavating the existing embankments shall be used as far as practicable in the formation of fills or embankments and at such other places on the Work as may be necessary. Excess excavated material shall be disposed of in appropriate areas selected by the Contractor.

When unsuitable material is encountered in the subgrade beyond the limits of the typical section, it shall be excavated as directed by the City's Project Manager. The limits of such over-excavation shall be approved by the City's Project Manager and the material removed from the subgrade, shall be hauled and deposited at an appropriate location. Additional suitable material shall be obtained by the Contractor and incorporated into the fill according to the compaction requirements specified in Chapter 2.

When over-excavation of material in a cross section is identified on the plans to establish uniform density, the excavated materials may be used in the finished section, provided that the compaction and moisture requirements in Chapter 2 are satisfied.

When the amount of suitable excavated material within the limits of the Work is not sufficient or accessible in time to complete the fills or embankments, the City's Project Manager shall be notified by the Contractor of proposed borrow location(s) at least one week in advance of construction. The use of the proposed borrow shall not be authorized until sampling and testing of the proposed borrow material(s) has been completed and suitability based on compliance with all project requirements has been determined to the satisfaction of the City's Project Manager.

When so designated on the plans, borrow shall be taken from the designated areas in conformance with lines and grades furnished by the City's Project Manager. When completed, all areas shall be left in a neat condition with no sharp breaks in contour, and shall be sloped to drain without causing damage to adjacent properties.

During progress of the Work, the excavation shall be maintained comparatively smooth and, in such condition, that it shall adequately drain at all times.

B. BASIS OF PAYMENT

Final measurement of the various specified quantities of excavation shall not be made. The quantity shown on the plans shall be an established quantity and shall be the basis of payment at the contract unit price per cubic yard bid for EXCAVATION, OVER-EXCAVATION, OR EXCAVATION BORROW. EXCAVATION when called for on the plans is the quantity of material to be removed and subsequently used to construct embankments in order to complete the required section. OVER-EXCAVATION when called for on the plans shall be the quantity of material to be removed and re-compacted prior to completing the required section. EXCAVATION BORROW when called for on the plans shall be the quantity of material that must be obtained off site in order to complete the required section. All such payments shall be full compensation for all stripping of vegetation, conservation of top soil, excavation, over-excavation, compaction, incorporation of water when required, materials, equipment, tools, labor and incidentals necessary to complete the Work.

When authorized by the City's Project Manager, removal of unsuitable material shall be measured and added to the established quantities as an EXTRA WORK item.

2.05 EXCAVATION (Continued)

B. BASIS OF PAYMENT (Continued)

All the aforementioned quantities are established by average end areas of the cross-sections with no balance factor used. These quantities do not include material excavated for pipe trenches, inlets, retaining wall, bridge abutments or any other appurtenances installed in the completed section. Those excavated materials shall be subsidiary to other items of Work for which direct payment is made.

2.06 DISPOSAL OF SURPLUS MATERIALS

A. GENERAL

All excavated material not required or suitable for fills or other designated purposes shall be removed from within the limits of the Work and deposited at an appropriate, off-site location.

Surplus materials shall, in general, be removed and disposed of before the subgrade has been completed and before any construction materials are placed.

Surplus materials, if left on the project site and placed on public or private property, shall be dumped, spread and finished to grades as designated.

B. BASIS OF PAYMENT

Final measurement of the specified quantity of surplus material shall not be made. EXCAVATION DISPOSAL, when called for on the plans, shall be the quantity of excess material measured in cubic yards which must be removed from the site and disposed of at an appropriate, off-site location. All such payments shall be full compensation for equipment, tools, labor and incidentals necessary to complete the Work.

2.07 CONSERVATION OF TOP SOIL

Topsoil shall be carefully removed and deposited in storage piles at the job site or as directed by the City's Project Manager for the purpose of parking space finishing. Topsoil shall be kept separate from other excavated materials and shall be piled free from roots, stones and other undesirable material.

No direct payment will be made for conservation of topsoil. Topsoil conservation shall be considered subsidiary to other items of Work for which direct payment is made.

2.08 EMBANKMENT

A. GENERAL

EMBANKMENT shall be defined as the raised soil structure of the street and all other fill areas associated with the construction of the project.

Areas to be filled shall be stripped of all vegetation and other debris. The stripped material shall be disposed of as hereinafter specified.

Fills and embankments shall be constructed of approved material and shall not contain any large logs, stumps, brush, sod, roots, weeds, debris or other perishable matter. Thoroughly pulverized sod mixed with earth may be deposited in the fill only when authorized by the City's Project Manager.

2.08 EMBANKMENT (Continued)

A. GENERAL (Continued)

No stones or rocks larger than 3" in diameter will be allowed in the top 2' of the constructed embankment. No stones or rocks larger than 8" in diameter will be allowed below the top 2' of the constructed embankment.

When widening existing embankments, the side of the existing embankment shall be plowed or stepped and all stripped material may be placed at the toe of the slope before the placing of additional material. All fills shall be placed in horizontal layers which shall not exceed 6" in depth after rolling. Before rolling, each successive layer shall be leveled with appropriate equipment. Only approved earth which can be suitably compacted shall be used.

Each successive layer of material placed as described shall be compacted by rolling to a density of not less than 96% of the maximum density as determined by AASHTO Standard Method T99. The moisture content of the earth in each layer shall be such that the specified density can be obtained and shall be adjusted if necessary so that it will be between 2% below and 4% above the Optimum Moisture Content, as determined by the standard test specified above.

When the moisture content of the material is too low, sufficient water shall be added to the material before it is excavated or to each layer before compaction. If excessive moisture is present, the material shall not be used or the material may be aerated until such excess moisture has dissipated. If, in the opinion of the City's Project Manager, the fill has been damaged due to precipitation, retesting shall be required. If the retesting indicates excessive moisture, the material shall be reworked or replaced.

The material shall not be compacted before it is thoroughly mixed and uniform in moisture content as above specified. The compaction shall be accomplished with equipment approved by the City's Project Manager.

B. BASIS OF PAYMENT

Final measurement of embankment shall not be made. The quantity shown on the plans shall be an established quantity and shall be the basis of payment at the contract unit price per cubic yard bid for EARTHWORK MEASURED IN EMBANKMENT. EARTHWORK MEASURED IN EMBANKMENT is the amount of material to be placed and compacted to complete the required section. Quantities are established by average end areas of the cross-sections with no balance factor used. Such payment shall be full compensation for all loading, hauling, spreading, compacting and other materials, equipment, tools, labor and incidentals necessary to complete the Work in conformance with these Standard Specifications and accepted by the City's Project Manager.

2.09 PARKING SPACE FINISH

A. GENERAL

The parking space is hereby defined as that part of the street right-of-way within the limits of the Work, exclusive of paved street and exclusive of space actually occupied by sidewalks or driveways. The parking space finish shall begin after the completion of all paving, driveway and sidewalk.

The above specified areas shall be fine graded to the exact lines and elevations indicated on the plans or as directed by the City's Project Manager. In general, they shall be covered with a seed bed, 2" in thickness, of selected topsoil reserved for this purpose at the time grading

2.09 PARKING SPACE FINISH (Continued)

A. GENERAL (Continued)

operations were performed. In the event that the reserved material is unsuitable, the Contractor will be required to provide a suitable material. The layer of topsoil shall be hand raked and shall be free from sod, stones, roots, clods and other objectionable foreign materials. All objectionable material shall be removed and disposed of as hereinbefore provided under "Disposal of Surplus Materials".

B. BASIS OF PAYMENT

PARKING SPACE FINISH performed in conformance with the Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per square yard. Such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the Work.

2.10 SUBGRADE

A. GENERAL

The subgrade is hereby defined as that portion of the street or alley, within the limits of the Work, which forms the foundation for the pavement or the curb or curb and gutter, and which is within the first 12" of soil below the pavement. After all earthwork has been substantially completed as herein specified, the subgrade shall be cut or trimmed to the exact lines, grade and cross-section shown on the plans or as directed by the City's Project Manager.

The subgrade for Portland Cement Concrete Pavement and Portland Cement Concrete Base shall be constructed to a uniform density of not less than 96% of the maximum density (as determined by AASHTO Standard Method T 99) throughout its entire width. The subgrade for full depth Asphaltic Concrete Pavement shall be constructed to a uniform density of not less than 100% of the maximum density (as determined by AASHTO Standard Method T 99) throughout its entire width.

The moisture content of the earth in each layer shall be such that the specified density can be obtained and the moisture adjusted, if necessary, so that it will be between two percent below -2% and above +4% the optimum moisture content (as determined by AASHTO Standard Method T 99). All soft or yielding material and other portions of the subgrade which will not compact readily shall be removed as directed, and any loose rock or boulders found shall be removed or broken off at a depth of not less than 12" below the surface of the subgrade. All holes or depressions made by the removal of material, as described above, shall be filled with approved material and compacted.

B. SUBGRADE PREPARATION

Immediately prior to paving, the entire subgrade for concrete pavement must be thoroughly and uniformly manipulated and re-compacted with the methods described above.

The elevation of the subgrade shall be carefully checked by the Contractor using a template or by such other methods as shall be approved by the City's Project Manager. No subgrade shall be accepted until it has been brought to the exact lines, grade and elevations indicated on the plans or as directed by the City's Project Manager. No pavement or foundation material shall be placed on any subgrade before the same is accepted by the City's Project Manager.

2.10 SUBGRADE (Continued)

B. SUBGRADE PREPARATION (Continued)

The Contractor shall maintain the subgrade to the specified section free from ruts, waves and undulations and in case any such objectionable irregularities occur for any reason, the subgrade shall be reshaped and re-rolled as necessary.

The Contractor shall protect the subgrade from damage due to precipitation and no water shall be allowed to remain on the subgrade.

If, in the opinion of the City's Project Manager, the subgrade has been damaged due to precipitation, retesting shall be required. If the testing indicates excessive moisture, the subgrade shall be reworked or replaced.

C. SUBGRADE STABILIZATION

If called for in the plans or contract documents or as directed by the City's Project Manager, sandy areas of the subgrade shall be stabilized with the addition of cohesive soil.

This work shall include obtaining and thoroughly mixing the cohesive soil with the sandy subgrade to the satisfaction of the City's Project Manager, adjusting the moisture and compacting the subgrade to the specifications as noted above.

It shall also include adjusting the grade lines to conform to the plans and disposal of surplus, excavated or profiled material.

If called for in the plans or contract documents or as directed by the City's Project Manager, wet areas of the subgrade shall either be stabilized with the addition of fly ash or hydrated lime or replaced with crushed limestone or crushed concrete.

This work shall include providing and thoroughly mixing fly ash or hydrated lime with the wet subgrade material to the satisfaction of the City's Project Manager and compacting by a Contractor established rolling pattern to the satisfaction of the City's Project Manager or coring out the subgrade to the depth as shown in the plans or contract documents or as directed by the City's Project Manager, and replacing with crushed limestone or crushed concrete. The crushed limestone or crushed concrete shall be provided by the Contractor and placed in the cored-out area in 6" lifts and compacted by a Contractor established rolling pattern to the satisfaction of the City's Project Manager. It shall also include adjusting the grade lines to conform to the plans and disposal of surplus, excavated or profiled material.

D. BASIS OF PAYMENT

No direct payment will be made for the preparation and compaction of the subgrade. It shall be considered subsidiary to other items of Work for which direct payment is made.

SUBGRADE STABILIZATION performed in conformance with the Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per square yard. Such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the Work.

2.11 COLD WEATHER CONSTRUCTION

Fills and embankments shall be laid only upon a surface that is free from frost. The material being used for fill and embankment shall not contain any frozen material and shall be placed only when proper spreading, compacting and bonding with the existing surface can be obtained.

General clearing and grubbing and tree removal or stump removal shall have no winter time restrictions; these operations may be carried on at any time of the year. Consideration should be given to inconveniencing the public as little as possible.

2.12 SUBSTANTIAL COMPLETION

All projects involving items of paving shall be considered substantially complete when all items of Work shown on the proposal or called for in any other area of the Contract documents are completed to the satisfaction of the City's Project Manager. Such items shall include but will not be limited to: curb and gutter, Asphaltic Concrete pavement/Portland Cement Concrete (PCC) pavement, driveways, sidewalks, alley returns, adjustment of manholes, valve boxes, water stop boxes, backfilling, park spacing, joint sealing, and pavement markings.

Liquidated damages shall continue to accrue until such time as the Work is deemed to be substantially completed by the City's Project Manager. However, the Contractor may submit a written request to the City's Project Manager for approval to suspend such liquidated damages to allow additional time for completion of minor items of the work, such as seeding, sodding, and survey monuments. Granting the request for additional time by the City's Project Manager shall not relieve the Contractor of the Contractor's responsibilities for completion of those items for which the suspension is requested.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 3

PORTLAND CEMENT CONCRETE (PCC)

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CHAPTER 3

PORTLAND CEMENT CONCRETE

3.00 GENERAL

Portland Cement Concrete (PCC) shall consist of an intimate mixture of Portland Cement, aggregate, and water. All Portland Cement Concrete (PCC) shall be air entrained and contain a City Engineer approved water reducing admixture at the manufacturers recommended dosage rate. Portland Cement used in all concrete mixtures except L-5500, LB-3500, LB-2750 and PR shall be an Inter-ground/Blended cement as described below and as indicated in Table 3.01 B. Depending on the application, other constituents or admixtures may be used with permission from the City Engineer. Materials not on the latest edition of the Nebraska Department of Transportation (NDOT) “Approved Products List” or “Nebraska Qualified Material Vendors List” shall not be used without permission from the City Engineer. The constituents of Portland Cement Concrete and their mixing, handling, and proportioning shall conform to ASTM Designation C 94 except as modified herein.

Unless stated otherwise in these specifications Concrete not meeting the 28 day required strength based on cylinders or maturity method as determined by the Engineer shall be removed and replaced at no extra cost to the City. Unless stated otherwise the Engineer may evaluate the concrete’s expected use and may allow it to remain in place at 50% pay.

3.01 MATERIALS

A. CEMENT

Portland Cement shall be a recognized standard hydraulic cement composed primarily of hydraulic calcium silicates conforming to the requirements of ASTM Designation C 150 for Type I, II, or III cement and shall contain no more than 0.60% equivalent alkali. Equivalent alkali is defined as the sum of the sodium oxide (Na₂O) and the potassium oxide (K₂O) calculated as sodium oxide (equivalent alkali as $\text{Na}_2\text{O} = \text{Na}_2\text{O} + 0.658(\text{K}_2\text{O})$). Certified mill tests shall be furnished to the City’s Project Manager. Different brands of cement, or the same brand from different mills, shall not be mixed during storage. Neither shall they be used alternately in any one concrete placement without permission from the City Engineer. Contractors or Subcontractors supplying concrete shall notify the City’s Project Manager when changing to different cement. No additional supplementary cementitious materials (SCMs) may be added at the concrete plant.

The cement shall be protected from damage due to moisture. Cement so damaged will be rejected. Cement shall not be in storage at the concrete plant longer than ninety (90) days without retesting for quality testing by a facility approved by the City Engineer. The temperature of the cement when used shall be less than 180° F.

B. INTER-GROUND/BLENDED PORTLAND CEMENT CONCRETE (PCC)

All Portland Cement Concrete (PCC) mixes, except those listed above shall be modified by the use of an Inter-ground/Blended cement and shall conform to the requirements in ASTM C595 and the following requirements as specified below.

3.01 MATERIALS (Continued)

B. INTER-GROUND/BLENDED PORTLAND CEMENT CONCRETE (PCC) (Continued)

1. Type IPF Cement

Type IPF cement shall be Portland cement which is pre-blended or inter-ground by the cement manufacturer with a replacement of 25% +/- 2% Class F fly ash and shall conform to the requirements of ASTM C 595. No additional SCMs may be added at the concrete plant.

Fly ash shall conform to the requirements of Class F pozzolan of ASTM Designation C 618, except that the maximum loss on ignition for Class F pozzolan shall be 6.0%. Additionally, Class F pozzolans shall have a maximum allowable free carbon content not to exceed 3.0%. Class F fly ash shall not contain more than 1.50% of available alkalis as Na₂O. Fly ash such as is produced in furnace operations utilizing liming materials or soda ash (sodium carbonate) as an additive will not be acceptable. Certified mill tests shall be provided to the City's Project Manager.

Type IPF may be further modified by a NDOT approved tertiary blend of cementitious materials provided they are incorporated into the final inter-ground/blended cement by the cement manufacturer.

2. Type IS Cement

Type IS cement shall be Portland cement which is pre-blended or inter-ground by the cement manufacturer with a replacement of 35% +/- 5% Slag (Ground Granulated Blast Furnace Slag). No additional SCMs may be added at the concrete plant.

Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Certified mill tests shall be provided to the City's Project Manager.

Type IS may be further modified by a NDOT approved tertiary blend of cementitious materials provided they are incorporated into the final inter-ground/blended cement by the cement manufacturer.

A City Engineer approved water reducing admixture shall be used in all inter-ground/blended modified concrete mixes at the dosage rate recommended by the manufacturer. The water-cement ratio of all inter-ground/blended modified concrete shall not exceed the maximum limit for the various classes of concrete as shown in Table 3.01 B.

C. AGGREGATE

1. General

Only aggregates that have been approved by the Nebraska Department of Transportation and used for similar Work and have satisfactory service records will be allowed for use on City of Lincoln projects unless approved by the City Engineer.

Mineral aggregates shall be crushed rock, broken stone, gravel, sand-gravel, coarse sand, fine sand, or a mixture of these materials composed of clean, hard, durable, and un-coated particles. Crushed rock shall be crushed limestone, dolomite, granite, quartzite, or other ledge rock.

3.01 MATERIALS (Continued)

C. AGGREGATE (Continued)

1. General (Continued)

Dolomite as herein defined is a magnesium limestone containing calcium carbonate and magnesium carbonate in approximately a 4 to 3 ratio.

The calcium carbonate content of limestone shall be at least 80% computed as CaCO_3 from the value determined for CaO .

Aggregates shall be free from injurious quantities of dust, soft or flaky particles, loams, alkali, organic matter, paper, wood, or other deleterious matter as determined by the City's Project Manager.

The use of aggregate obtained from any reclaiming or recycling process shall not be allowed without permission from the City Engineer.

The gradations shown for the aggregate represent limits which shall determine suitability for use from any source of supply. The gradations from any one source shall be uniform and not subject to the extreme percentages of gradation specified below. The aggregate from different sources of supply shall not be mixed or stored in the same pile, nor used alternately in the same class of construction or mixed without permission from the City Engineer. The aggregate may be tested at any time prior to its incorporation into a mix. Aggregate sampling and testing shall conform to the following requirements:

<u>ASTM</u>	<u>DESIGNATIONS</u>
C33	Specification for Concrete Aggregates

<u>AASHTO</u>	<u>DESIGNATIONS</u>
T96	Abrasion
T104	Sodium Sulfate Soundness
T21	Organic Impurities
T71	Mortar-Making Properties
T84	Specific Gravity and Absorption (Fine Aggregate)
T85	Specific Gravity and Absorption (Coarse Aggregate)
T89	Determining the Liquid Limit of Soils
T90	Determining the Plastic Limit and Plasticity Index of Soils
T248	Reducing Field Samples of Aggregate to Testing Size

NEBRASKA DEPARTMENT OF TRANSPORTATION

NDOT T2	Sampling
NDOT T27	Sieve Analysis
NDOT T504	Clay Lumps, Shale, and Soft Particles
NDOT T103	Freeze and Thaw Soundness
NDOT C25	Calcium Carbonate

Fine sand shall have at least 95% of its particles pass the No. 10 sieve and no more than 25% pass the No. 200 sieve. This definition applies to the sodium sulfate soundness test.

3.01 MATERIALS (Continued)

C. AGGREGATE (Continued)

1. General (Continued)

Once an aggregate's soundness and abrasion quality has been determined, additional quality testing for soundness and abrasion loss will be at the City's Project Manager's discretion.

Aggregate shall be evaluated based upon its past performance in concrete pavement and in laboratory test results. Aggregate with adversely reactive constituents shall not be used.

During the progress of the Work, should the quality of the aggregate appear to change appreciably, the Contractor may be required to furnish satisfactory evidence of its soundness. The City's Project Manager may, from time to time during the progress of the Work, make check tests of the gradation of the aggregates. Any materials failing to meet the requirements of the Standard Specifications shall be rejected and removed from the site of the Work.

Aggregates shall meet the gradation requirements of Table 3.01 A, for the Class of Concrete shown in Table 3.01 B, of these Standard Specifications. For all other applications such as overlay concrete or mortar and grout sands, the gradation requirements in the latest edition of the Nebraska Department of Transportation "Standard Specifications for Highway Construction" shall apply.

2. Fine Aggregate

Fine aggregate shall consist of sand or sand gravel or a combination of sand and sand gravel. The sand and sand gravel shall be washed and composed of clean, hard, durable and un-coated particles. Aggregates produced from wet pits by pumping will be considered to be washed. Aggregates from a dry pit shall have the method for washing approved by the City Engineer. The fine aggregate shall be free from injurious amounts of clay, loam, alkali, organic matter and other deleterious substances.

Fine aggregate shall have a soundness loss of not more than 10% by weight at the end of 5 cycles using sodium sulfate solution.

The aggregate shall contain no more than 0.5% by weight of clay lumps.

The aggregate which produces a color darker than the standard color when subjected to the colorimetric test for organic impurities shall be tested for its mortar-making properties in conformance with AASHTO T 71.

The aggregate, when subjected to the mortar-making properties test, shall produce a mortar having a compressive strength at the age of 7 days equal to or greater than that developed by mortar of the same proportions and consistency made of the same cement and aggregate after the aggregate has been treated in a 3% solution of sodium hydroxide. Materials failing to produce equal or greater strength shall not be accepted, without permission from the City Engineer.

3.01 MATERIALS (Continued)

C. AGGREGATE (Continued)

3. Coarse Aggregate

Coarse aggregate shall consist of limestone composed of clean, hard, durable, and uncoated particles. These materials are natural sedimentary rock composed principally of calcium carbonate.

The calcium carbonate content of the aggregate shall be at least 80% (computed as CaCO₃ from value determined for CaO).

The percent of clay lumps, shale, or soft particles shall not exceed the following amounts:

Clay Lumps	0.5%
Shale	1.0%
Soft Particles	3.5%

Any combination of clay lumps, shale and soft particles shall not exceed 3.5%.

Coarse aggregate for concrete shall be free of coatings that will inhibit bond and injurious quantities of loam, alkali, organic matter, thin or laminated pieces, chert or other deleterious substances.

Coarse aggregate for concrete shall not have a soundness loss greater than 8% by weight at the completion of 16 cycles of alternate freezing and thawing.

The percentage of wear by the Los Angeles Abrasion test shall not exceed 40%.

**TABLE 3.01A – GRADATION LIMITS FOR MINERAL AGGREGATES
FOR USE IN PORTLAND CEMENT CONCRETE (% Passing)**

Sieve	FINE AGGREGATE		COARSE AGGREGATE	
	Target	Tolerance	Target	Tolerance
1 1/2"	--	--	100	None
1"	100	None	100	-8
3/4"			78	±12
1/2"			--	--
3/8"			30	±15
# 4	87	±10	6	±6
# 10	60	±10	--	--
# 20	--	--	2	±2
# 30	28	±12		
# 50				
# 100				
# 200	1.5	±1.5		

3.01 MATERIALS (Continued)

D. WATER

Water for concrete or mortar shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter, and other deleterious substances. Test specimens of mortar made from the materials and water to be used in the Work shall develop a tensile or compressive strength at seven days of not less than 95% of that developed by the mixture of material and distilled water.

Wash-out water or water from the reclaiming process of Portland cement concrete shall not be allowed to be used in the mixture without permission from the City Engineer.

E. CHEMICAL ADMIXTURES

Portland cement concrete shall be air-entrained. Air entraining admixtures to be used with Portland Cement Concrete shall conform to ASTM Designation C 260, except that the strength of the concrete containing the admixture shall not be less than 92% of a similar concrete without the admixture at all test ages. The air entraining characteristics of the admixture, when combined in suitable proportions with Portland Cement, aggregate, and water, within the limits of the proportions specified, shall be such that the resulting concrete will have a satisfactory work-ability and a total air content within the limits, as specified herein, for the different classes of concrete.

If the air content of the concrete at the job site is less than the minimum specified, only one addition of air-entraining admixtures to a load is allowed. If the air content is then outside the limits specified, the load of concrete shall be rejected.

Admixtures which are not incorporated into the mix at the plant shall not be added to individual loads of concrete at the job site to enhance work-ability or pump-ability without permission from the City Engineer.

Admixtures shall not be added to individual loads of concrete at the job site to reduce either air content or slump without permission from the City Engineer.

TABLE 3.01B – PORTLAND CEMENT CONCRETE MIXTURES (CUBIC YARD BATCH)

CLASS OF CONCRETE (1)	GENERAL USE	CEMENT (lb/cy)	CEMENT TYPE (2)	WATER CEMENT RATIO (MAX.)	SLUMP (MAX.) (inches) (3)	AGGREGATES (% BY WEIGHT)		AIR CONTENT RANGE (% BY VOLUME)	28 DAY STRENGTH MIN. PSI
						FINE	COARSE		
SG-3000	Where Specified	564	1PF/IS	0.50	4.0	100	0	6.0 - 8.5	3000
L-3500	Pavement, Sidewalk, Structures	564	1PF/IS	0.50	4.0	70 +/- 3	30 +/- 3	6.0 - 8.5	3500
L-3500S	Slip-form Pavement	564	1PF/IS	0.48	2.5	70 +/- 3	30 +/- 3	6.5 - 9.0	3500
LC-3500	Slip-form Curb	564	1PF/IS	0.48	2.5	70 +/- 3	30 +/- 3	6.0 - 8.5	3500
L-4500	Structures	658	1PF/IS	0.42	4.0	70 +/- 3	30 +/- 3	6.0 - 8.5	4000
LB-2750	Pavement Base (New Construction Residential)	423	I/II	0.60	4.0	60 +/- 2	40 +/- 2	5.5 - 7.5	2750
LB-3500	Pavement Base (Reconstruction)	564	I/II	0.50	4.0	70 +/- 3	30 +/- 3	5.5 - 7.5	3500
L-5500	Pavement (High/Early Strength)	752	I/II	0.40	4.0	70 +/- 3	30 +/- 3	6.0 - 8.5	4000
PR (4)	Pavement Repair (High/Early Strength)	799	III	0.45	4.0	70 +/- 3	30 +/- 3	6.0 - 8.5	4000

NOTES:

(1) All mixtures shall contain a City Engineer approved water reducer at the manufacturer's recommended dosage rate.

(2) Type 1PF or Type IS may be used. For Temporary Pavement, Type I/II cement is allowed.

(3) The maximum slump may be exceeded by use of City Engineer approved mid to high range water reducers and/or superplasticizers.

(4) Calcium Chloride may be added as per NDOT Standard Specifications for Highway Construction.

This table is for proportion ranges only. Actual mix design weights for specific applications will be provided or approved by the City Engineer.

3.02 HANDLING MATERIALS

The concrete constituents, when delivered to the mixing equipment, shall meet the requirements of the above Standard Specifications.

The moisture content of the aggregate shall be reasonably uniform from batch to batch. During concrete mixing operations, aggregate moisture tests shall be performed, daily or more often as conditions warrant, by the Contractor on aggregates not controlled by electronic moisture probes. Weight adjustments shall be made accordingly to the aggregate proportions as changes in moisture content occur. Moisture test results shall be made available to the City's Project Manager upon request.

Limestone aggregate having a total moisture content less than the absorption percentage of the aggregate as determined by ASTM C127 shall not be approved for use in Portland cement concrete until it is uniformly saturated with water. The saturation shall be performed sufficiently in advance of mixing operations to accommodate moisture absorption by the aggregate.

3.03 WEIGHING & MIXING

A. CENTRAL BATCH PLANT

The constituents of the concrete shall be weighed or measured separately at a central batch plant. The central batch plant shall be in substantial compliance with the requirements in the Quality Control Manual, Section 3, Certification of Ready Mixed Concrete Production Facilities published by the National Ready Mixed Concrete Association. The Contractor shall be responsible for the calibration of the plant on an annual basis or as deemed necessary by the City Engineer.

The concrete batch shall be either plant-mixed by the central batch plant or truck-mixed using transit mixing trucks or a combination of both. Mixing time shall be in conformance with ASTM C 94 and rate requirements shall be based on the size of drum and the mixing drum manufacturers' Specifications. Mixing time shall start when the cement and water are combined. Agitation of the concrete during transport at a lower rate than the drum manufacturer's mixing specification shall not count toward approved mixing time. The concrete shall be transported to the job site in clean, water tight trucks. A load ticket showing the date, time, plant designation, mix designation, batch size, material quantities per batch, and aggregate moisture values used to calculate aggregate quantities shall accompany each load and be made available to the City's Project Manager.

The temperature of the concrete shall be between 50° F and 95° F when delivered to the Work. The temperature of the combined aggregate and water shall not exceed 95° F.

B. SELF-CONTAINED MOBILE MIXER

Use of this method shall be pre-approved by the Engineer and shall be limited to a maximum of 30 cubic yards per day.

Proportioning and mixing equipment shall be of the self-contained, mobile, continuous mixing type capable of volumetric production of concrete meeting the mix proportions stated in this Chapter and subject to the following.

The mixer shall be self-propelled and be capable of carrying sufficient unmixed dry, bulk cement, fine aggregate, coarse aggregate, admixtures, and water to produce on the site at least 5 cubic yards of concrete. The mixer shall have one bin for each size aggregate.

3.03 WEIGHING & MIXING (Continued)

C. SELF-CONTAINED MOBILE MIXER (Continued)

1. Control and Mixing of Materials

Unless otherwise stated in these specifications, operation and calibration of the mixer shall follow sections 7, 8, and 9 of ASTM C685/17.

The Contractor shall perform calibration tests according to the equipment manufacture's recommendations every 6 months and when there is a change in the mix design proportions or source of materials. A cement meter calibration shall be performed at the beginning of each project. The Engineer shall be notified prior to the calibration so the process can be observed. The Engineer may require a calibration test or yield check whenever a change in the characteristics of the mixture is observed. Calibration reports and sources of materials shall be kept with the mixer for 2 years and be readily available to the Engineer.

At the end of the concrete placement a printed batch ticket shall be submitted to the Engineer and shall contain the following information. Name of concrete supplier, identification number of batching equipment, serial number of batch ticket, date, starting time, finishing time, name of purchaser, specific designation of job (name and location), designation of concrete mix, amount of concrete in cubic yards, meter count, indication of total quantity of cement, aggregates, water, and admixtures batched.

The temperature of the concrete shall be between 50° F and 95° F when delivered to the Work. The temperature of the combined aggregate and water shall not exceed 95° F.

3.04 CONSISTENCY AND PLACEMENT OF CONCRETE

In general, the minimum amount of water shall be used which will produce the required workability. The mortar shall cling to the coarse aggregate and shall show no free water when removed from the mixer. The upper surface of the set concrete shall show a cement film upon the surface, but shall be free from laitance. In no case shall so much water be used so as to cause the collection of surplus water on the surface, or to cause segregation of the materials during transportation or placing of the concrete.

Concrete shall be plastic, cohesive and workable, and uniform from load to load. Workable concrete is defined as a concrete which can be placed without honeycomb and without surface voids. Work-ability shall be obtained without producing a condition such that free water appears on the surface when finished. The consistency of the mixture shall be that required for the specific conditions and methods of placement; however, the maximum water cement ratio, as specified in Table 3.01 B, shall not be exceeded.

Concrete hauled in non-agitating trucks shall be placed within 30 minutes after mixing time starts. Concrete hauled in agitating or transit mix trucks shall be placed within 90 minutes after mixing time starts. A lesser time may be specified by the City Engineer if, in his/her opinion, conditions warrant it. Concrete exceeding these time limits shall not be incorporated in the pavement or structure.

The maximum allowable interval for placing successive concrete loads on grade for paving or into forms and excavations for structures shall be 30 minutes unless directed otherwise by the City Engineer. Concrete free fall distance shall not exceed 5'. This includes free fall in a discharge pipe when using a conveyor system for placement. Pumped concrete is not considered in free fall until the concrete exits the pumper hose.

3.05 CONCRETE ACCEPTANCE

The Contractor shall notify the City a minimum of 48 hours in advance of the intended concrete placement to allow for inspection of the grade, forms and reinforcement and to enable sampling and testing of the concrete materials at the plant and testing of the concrete at the jobsite. The City Engineer shall take such tests of the concrete as he/she deems necessary to determine the strength and the air, water, cement and aggregate proportions. The properties of the concrete will be determined by the tests specified in ASTM Designation C 94. Any concrete placed without the proper notification will be subject to removal and replacement.

3.06 FLOWABLE FILL

A. DESCRIPTION

Flowable Fill for general use shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.

B. MATERIALS

The approximate quantities of each component per cubic yard of mixed material shall be as shown in Table 3.06 A. Other materials and amounts may be used depending on the intended application of the flowable fill with approval of the City Engineer.

TABLE 3.06A – FLOWABLE FILL COMPOSITION PER CUBIC YARD

Cement (Type I or II)	60 pounds
Class C Fly Ash	200 pounds
Fine Sand (ssd)	2,700 pounds
Water (approx.)	420 pounds
Air Content (approx.)	10%

Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.

Approximate compressive strength should be 85 to 175 psi.

Fine Sand shall be an evenly graded material having not less than 95% passing the No. 4 sieve and not more than 5% passing the No. 200 sieve.

Handling and mixing of the materials shall be in conformance with these Standard Specifications.

Cement must be on the latest NDOT Approved Products List or “Nebraska Qualified Material Vendors List”.

3.06 FLOWABLE FILL (Continued)

C. BASIS OF PAYMENT

FLOWABLE FILL that has been completed in conformance with the Plans and Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per cubic yard based on the ticketed volume of material delivered to the site. No payment shall be made for materials furnished in excess of that specified in the Contract or approved by the City's Project Manager. Such payment shall be full compensation for all materials, hauling, installing, equipment, tools, labor and incidentals necessary to complete the Work.

3.07 HOT/COLD WEATHER CONSTRUCTION

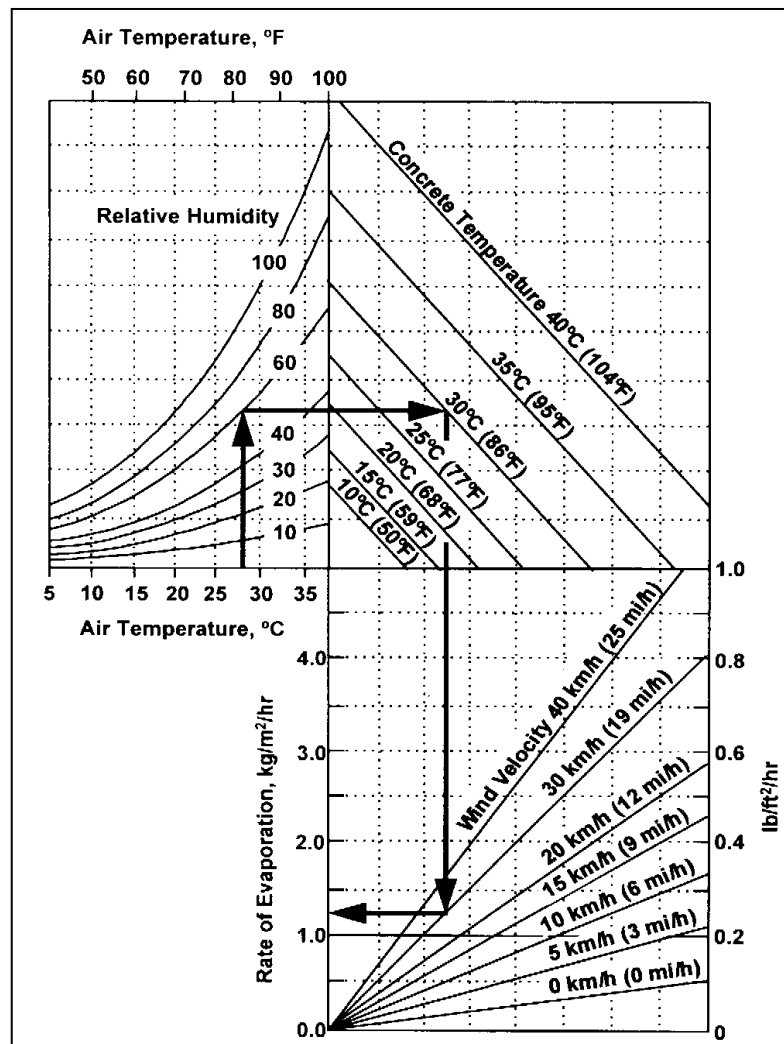
A. CONCRETE CONSTRUCTION – HOT WEATHER

To reduce plastic shrinkage and cracking, the following conditions shall be considered:

1. Concrete temperatures
2. Air temperatures
3. Humidity
4. Wind velocities

When these conditions combine to create a rate of evaporation equal to or greater than 0.2 pounds per square foot per hour (as determined by Figure 3.07), the Contractor shall take action, satisfactory to the City's Project Manager, to prevent plastic shrinkage cracking.

FIGURE 3.07 - HOT WEATHER CONCRETING EVAPORATION NOMOGRAPH



3.07 HOT/COLD WEATHER CONSTRUCTION (Continued)

B. CONCRETE CONSTRUCTION – COLD WEATHER

Concrete shall not be placed in inclement weather except with permission from the City Engineer. The air temperature for placing concrete shall be 35° F and rising. No concrete shall be placed on a frozen sub-grade. When air temperatures can be anticipated below 35° F, the concrete shall be preheated such that the temperature of the fresh concrete in place is a minimum of 55° F. Concrete aggregates shall be protected to prevent freezing and to maintain total moisture content above the absorption percentage of the aggregate as determined by ASTM C127.

The pavement or structure shall be maintained for 72 hours at a minimum of 50° F with heat and/or adequate layers of burlap, plastic, insulated blankets, or other approved materials. No open flame heat source without proper venting to protect the fresh concrete from the exhaust gases.

The concrete shall have achieved the minimum specified strength prior to any subsequent construction or loading of the pavement or structure. If deemed necessary, the Engineer may require a 28 day strength core to verify that the concrete has not been damaged by the cold weather. The core shall be taken at no additional cost to the City within 35 days of placement, under the direct supervision of the Engineer and taken to the City Lab for testing. Any failure to meet specified strength will be subject to the strength pay factors in Section 4.14.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

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PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

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CHAPTER 4

PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

4.00 GENERAL

Portland Cement Concrete (PCC) pavement shall refer to, but not be limited to, streets, alleys, sidewalks, driveways, bikeways, concrete curbs and medians. All pavements to be constructed or reconstructed under each contract shall be placed at the locations shown on the plans, on an approved subgrade, in conformance with these Standard Specifications and in conformity with the lines, grades, typical cross section, and details shown on the plans and/or as directed by the City's Project Manager, and shall be subject to the payment factors in 4.14 with the exception of Pavement Repairs covered in 4.12

Pavement construction and reconstruction shall include all necessary removal of existing headers, pavement, sidewalks and drives; clearing, grubbing and stripping, excavation within the limits of the Work, removal of obstructions, removal and disposal of unsuitable material and debris, borrow excavation, construction of fills and embankments, haul, preparation and compaction of the subgrade; the construction of curbs, base, pavement, driveways, sidewalks; trimming, shaping and finishing of the parking space; excavation of ditches, grading and construction of approaches on intersecting or entering streets, alleys, driveways, and any other items of Work necessary to conform to these Standard Specifications and the lines, grades and cross sections shown on the plans, all as directed by the City's Project Manager.

4.01 MATERIALS

Portland Cement Concrete (PCC) pavement shall be constructed of the materials as herein specified. All materials used in pavement construction and reconstruction shall be on the latest edition of the Nebraska Department of Transportation "Approved Products List" or "Nebraska Qualified Material Vendors List" unless otherwise approved by the City Engineer.

A. CONCRETE

Portland Cement Concrete (PCC) Pavement shall be class L-3500 concrete, as defined in Chapter 3, of the thickness, and with or without reinforcement, as shown on the plans unless otherwise specified. In the case of curbs, LC3500 is also an acceptable alternative.

B. REINFORCEMENT

All reinforcement bars shall conform to the requirements of "Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement" ASTM A 615, Grade 40 (300) or grade 60 (420). Bars shall be free from rust, scale, or other substances which prevent the bonding of the concrete to the reinforcement, excluding greasing of dowel bars as required in the plans and or in the contract. Smooth dowel bars shall be epoxy coated and conform to the requirements of "Structural Steel", ASTM A36. All dowel and tie bar reinforcement in PCC pavement shall be epoxy coated and conform to the requirements of ASTM A775/A775M – 17.

The epoxy coating shall be free from holes, voids, contamination, cracks, or other damaged areas. A suitable patching material compatible with the coating and inert in concrete shall be made available to the Contractor by the manufacturer of the epoxy resin for repair of damaged coating areas at the applicator's plant or in the field. The patching or repair shall be performed in conformance with the recommendations of the material manufacturer.

4.01 MATERIALS (Continued)

B. REINFORCEMENT (Continued)

Patching materials supplied or recommended by the manufacturer of the powdered resin shall be used to repair the coating and shall be applied to provide a minimum film thickness of 5 mils (125 μm) over the bare area. Areas to be patched shall be clean and free of surface contaminants. They shall be properly treated in conformance with the resin manufacturer's recommendations before detrimental oxidation occurs.

Care should be taken during the patching procedure to assure that the coating thickness on the area adjacent to the patched area does not exceed 15 mils (375 μm). Extensive areas of damaged coating, exceeding that which is unavoidable in careful handling and shipping, may be cause for rejection of the damaged bars.

In no case, however, shall the total bar surface area covered by patching material exceed 5%. (The 5% total bar surface area is the combined area for repairs done in the fabricator's shop and those done in the field.)

Proper repairs shall be the Contractor's responsibility even when the work is done by an applicator, fabricator, or other subcontractors.

C. REINFORCING BAR SUPPORTS

Reinforcing bar supports for use in concrete pavement shall be of a design and material satisfactory to the City's Project Manager and of sufficient strength to hold the metal reinforcement in place while the concrete is being placed.

D. METAL DOWEL OR EXPANSION BAR SLEEVE

Metal or plastic sleeves for dowel or expansion bars shall be satisfactory to the City's Project Manager and shall be of sufficient size and strength to permit the free sliding of the dowel bar after the concrete is in place.

E. PREFORMED EXPANSION JOINT MATERIAL

For Streets, expansion joint material shall conform to "Standard Specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction" (non-extruding and resilient bituminous types) ASTM Designation D 1751. The joint material shall be 1" thick unless otherwise specified.

For all other applications, expansion joint material shall conform to "Standard Specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction" (non-extruding and resilient bituminous types) ASTM Designation D 1751 or "Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction" ASTM Designation D 1839. The joint material thickness shall be per Lincoln Standard Plans unless otherwise specified.

F. JOINT AND CRACK SEALER

Joint sealer shall conform to the requirements of ASTM D 6690 Type II, "Standard Specification for Joint Sealant, Hot-Applied Elastomeric-Type, for Portland Cement Concrete Pavement", and shall meet or exceed the testing requirements of ASTM D 5329, "Standard Test Method for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavement". The flow as specified in ASTM D 5329 shall not exceed 3/4".

4.01 MATERIALS (Continued)

G. CURING COMPOUNDS

All curing compounds shall be of the white pigmented liquid membrane-forming type and shall conform to "Standard Specifications for Liquid Membrane -Forming Compounds for Curing Concrete", ASTM Designation C 309, Type 2, Class A. Only curing compounds included on the latest edition of the NDOT Approved Products list or "Nebraska Qualified Material Vendors List" shall be used unless otherwise approved by the City Engineer.

All curing compounds shall be ready for use as is without further dilution. The rate of application shall be as recommended by the manufacturer, or as stated in these specifications.

H. METAL KEYWAY

Metal keyway, where shown, shall conform to the gauge and cross section shown in the Lincoln Transportation and Utilities Standard Plans.

4.02 PREPARATION OF SUBGRADE

No measurement or direct payment shall be made for preparation of subgrade. The cost of preparation of subgrade shall be considered subsidiary to the other items of Work for which direct payment is made.

The subgrade shall be prepared as specified in Chapter 2 of these Standard Specifications. To prevent the absorption of moisture from the newly deposited concrete, the subgrade shall be kept moist by light applications of water until the concrete has been placed.

4.03 FORMS

A. GENERAL

No direct payment shall be made for forms. The cost of form work shall be considered subsidiary to other items of Work for which direct payment is made.

Upon complete removal of the forms, all honeycombed areas or small defects shall be properly pointed up with an approved grout mix and the concrete previously protected by the forms shall be cured as hereinafter specified or as directed by the City's Project Manager.

B. RIGID FORMS

Forms shall be of an approved steel section with a minimum base width of 6" and shall have adequate locking devices. The forms shall have a minimum length of 10' for street paving. The forms shall be built straight and true and in conformance with established line and grade. On curves having a radius of less than 150', approved forms may be used. The depth of forms shall equal at least the depth of the concrete to be placed. No built-up forms will be permitted without prior approval of the City's Project Manager.

All forms shall be free from bends and warps at all times. They shall be cleaned thoroughly each time they are used and adequately oiled before concrete is placed against them. The forms shall be set so that they rest firmly throughout their entire length on the thoroughly compacted subgrade. They shall be neatly and tightly joined. They shall be accurately set to line and grade and sufficiently braced to resist the pressure of the concrete. Forms shall be set at least 150' ahead of the paving operation.

4.03 FORMS (Continued)

B. RIGID FORMS (Continued)

The forms shall not be removed until new concrete is at least 12 hours old unless approved by the City's Project Manager. During the operation of form removal, the edges of the concrete shall be cured as hereinafter specified.

When concrete pavement is being laid contiguous to previously finished pavement of the same finished grade elevation or contiguous to previously finished independent curb or curb and gutter, such finished pavement or curb may be made to serve as side forms.

Upon removal of the forms, all honeycombed areas or small defects shall be pointed up properly with an approved mix grout.

For Sidewalks, Driveways, and Bikeways only, the Contractor shall erect substantial forms of a material approved by the City's Project Manager. Unless otherwise shown on the plans, sidewalks and bikeways shall be constructed so that, when finished, they shall have a uniform transverse slope toward the curb of 2%.

C. SLIP FORMS

Slip form equipment shall be provided with traveling side forms and screed of suitable dimensions, shapes, and strength to support the concrete for a sufficient length of time during placement to produce the required cross section. The equipment shall spread, consolidate and screed 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 for both line and grade which operate from an offset control line.

All curbs shall be constructed using slip form paving equipment, except when specifically authorized by the City's Project Manager. At the option of the Contractor and with the approval of the City's Project Manager, slip form equipment may be used for construction of concrete sidewalks or bikeways.

4.04 PLACING REINFORCING STEEL / TIE BARS

No measurement or direct payment will be made for reinforcing steel or Tie bars. The cost of furnishing and placing reinforcing steel or Tie Bars shall be considered subsidiary to other items of Work for which direct payment is made.

All reinforcing steel shall be kept clean and free from foreign material that will prevent the proper bond with the concrete. Reinforcement steel / tie bars shall be placed as shown on the plans or Lincoln Transportation and Utilities Standard Plans. Reinforcement steel / tie bars shall be placed between the concrete driveway and the pavement when a commercial drive is being constructed in conjunction with new paving. The length and location of the reinforcement steel / tie bars shall be as shown on the drawings. The Reinforcement steel / tie bars shall project equally into the driveway and pavement section. The reinforcement shall be placed so that the outside longitudinal members will be located no more than 3" from the edge of the slab section and the ends of all longitudinal members shall extend to within 2" of the ends of the slab sections. All steel reinforcing bars shall be tied securely in place at all points where the bars cross.

4.05 CONCRETE PLACEMENT

No measurement or direct payment will be made for placing and finishing the concrete. Placing and finishing the concrete shall be considered subsidiary to other items for which direct payment is made.

The concrete shall be deposited uniformly on the prepared subgrades and distributed to the required depth for the entire width by shoveling or other approved methods. The concrete then shall be consolidated thoroughly, using an approved vibrating screed or in a manner approved by the City's Project Manager. The concrete shall be so placed that no segregation of the materials occurs. It shall be struck off and finished, as hereinafter provided. Rakes shall not be used in handling concrete.

A. VIBRATING

No direct measurement or payment shall be made for vibrating or consolidation of the concrete. The cost of vibrating shall be considered subsidiary to other items of Work for which direct payment is made.

The concrete shall be well consolidated against the forms. All concrete, whether placed by machine or by hand methods, shall be thoroughly consolidated by means of mechanical vibrators approved by the City's Project Manager. The vibrator shall consolidate the full depth and width of the concrete to a uniform mass without segregation and free from excessive surface mortar at a single passage of the machine. Machine mounted vibrators shall be operated only when the machine to which they are attached is moving. The vibrators shall be placed so as to allow a minimum of overlap vibration. The vibration frequency shall be greater than 4,000 impulses per minute. The Contractor shall have a tachometer available to check the speed of the vibrators.

B. FINISHING

1. General Finishing

Finishing the concrete pavement shall not be measured and paid for directly. The cost of the finishing will be considered subsidiary to the cost of other Work for which direct payment is made.

Whether the consolidation and finishing of the concrete is accomplished by either machine or hand methods, the following requirements shall apply and all equipment used shall meet the approval of the City's Project Manager. Unless otherwise provided in the Special Provisions or approved by the City's Project Manager, hand finishing as described herein may be employed only in cases of emergency and where mechanical methods are impractical. The consolidation and finishing of concrete sidewalk, bikeway or driveway may be accomplished by either machine or hand methods.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. The proper use of an approved evaporation reducer is required instead. However, due to unavoidable delay in finishing or an unusual drying condition, a slight quantity of water may be added to the surface of the concrete as an aid in finishing. If it becomes necessary to sprinkle the surface with water to complete the finishing of the concrete, all mixing operations shall be immediately discontinued until the finishers catch up to a point where extra water for finishing is no longer required. If the application of water to the surface is permitted, it shall be applied in a fog spray by means of an approved orchard type sprayer. Spray equipment which is attached to the mechanical finisher, or any other paving equipment, will not be permitted.

4.05 CONCRETE PLACEMENT (Continued)

B. FINISHING (Continued)

1. General Finishing (Continued)

The addition of superficial water to the surface of the concrete shall be at the Contractor's risk. The pavement shall be given a finish by means of a wet burlap drag. The drag shall be pulled in a longitudinal direction only. The drag shall be adequately maintained so that the resultant finish shall be uniform in appearance. On sidewalks and driveways, the final finish shall be obtained with the use of a broom. Brooming shall be transverse to the direction of pedestrian traffic.

Prior to the time the concrete takes its initial set, all expansion and construction joints and exposed edges shall be carefully finished with an edger having a radius of not less than 1/4". The edge shall be left smooth and true to line and grade. The Contractor shall provide a suitable work bridge spanning the concrete placement to facilitate the edging.

2. Machine Finishing

The concrete shall be deposited in such a manner that adequate concrete remains ahead of the screed and the finish machine to provide the cross section required. The concrete will then be further consolidated and finished mechanically with a power driven, self-propelled machine approved by the City's Project Manager. The finish machine shall be operated over the entire width of the pavement section and shall achieve uniform consolidation. The tops of the forms and the contact surfaces of the wheels of the finishing machine shall be kept free from concrete and earth.

The finishing machine shall be kept in good repair at all times and shall operate so as to give the desired finish over the entire surface of the pavement. The forward speed of the finishing machine shall be adjusted to the average progress of the concrete production, in order that the strike off operation shall be as continuous and uninterrupted as possible.

After the final pass of the finishing machine, the surface shall be checked and corrected by using approved 10' long straight edges and refinished using long handled floats. The use of the long-handled floats shall be held to a minimum. The straight edge shall be lapped 1/2 its length on each successive position.

The Contractor shall furnish and keep in a convenient place a master straight edge, made of 6" steel channel, for the purpose of checking all straight edges and the longitudinal float during the progress of the Work. A sufficient number of straight edges shall be kept in readiness so as not to delay the paving operations.

Hand tools that perform the function of the finishing machine shall be immediately available for use in the event of an emergency.

3. Hand Finishing

After the concrete has been placed and spread, it shall be thoroughly consolidated by the use of approved vibrating screeds and struck off to a uniform height above the finished grade to the true cross section. When a non-vibrating hand screed is used or the pavement design thickness is greater than 6", the concrete shall be consolidated with an approved mechanical vibrator before the concrete is struck off.

4.05 CONCRETE PLACEMENT (Continued)

B. FINISHING (Continued)

3. Hand Finishing (Continued)

The screed used shall be of a design and construction suitable and adequate for the purposes required. It shall be designed to ride on the side forms of the pavement. The screed shall be of metal or steel shod wood and shall have sufficient strength and stiffness to retain its shape under all working conditions. The working or screeding edge shall be shaped to match the required cross section of the pavement. The screed shall be operated so that

when riding on the side forms, the working edge will have an excess of concrete above grade to produce the required cross section after consolidation.

After the concrete has been consolidated and struck off, the surface shall be finished as specified above under machine finishing.

C. SURFACE TESTS

After the pavement has been set sufficiently to permit foot traffic, the slab will be thoroughly checked by the City's Project Manager. All variations in excess of 1/8", measured from the surface of the concrete in place with a 10' straight edge or other device used for measuring deviations from a plane, shall be plainly marked. The Contractor shall eliminate such variations. When the surface finish of the pavement has been disturbed by grinding, the surface shall be repaired with the use of an approved sealant. The use of mechanical grinders will be permitted if their use does not, in the opinion of the City's Project Manager, damage the pavement. Sections of pavement containing depressions which cannot be corrected by grinding shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

4.06 JOINTS

No direct measurement or payment will be made for joints or joint sealant. The cost of jointing and joint sealing shall be considered subsidiary to other items of Work for which direct payment is made.

A. TRANSVERSE CONSTRUCTION JOINTS

At the end of the day, or in case of an unavoidable interruption of more than 30 minutes, a transverse construction joint shall be placed at the point of the Work stoppage. The joints shall conform to the requirements for construction joints as shown on the plans and as specified herein.

Whenever concrete pavement construction is stopped for a period of over 30 minutes, a transverse construction joint shall be formed by finishing the concrete to a bulkhead made of at least 2" material cut to the exact cross section of the pavement slab, as shown on the plans. The bulkhead shall be placed on the subgrade perpendicular to the pavement surface and at right angles to the center line of the street. An edging tool shall be used along the bulkhead to make the construction joint a well-defined line. Construction joints shall not be spaced closer than 10'. When the placing of concrete is resumed, the bulkhead shall be removed and care shall be taken not to disturb any steel or concrete placed. The new concrete shall be placed directly against the face of the concrete previously placed. The joint shall be formed and finished so the surfaces of the previously placed concrete and new concrete correspond exactly to the cross section and grade shown on the plans.

4.06 JOINTS (Continued)

B. EXPANSION JOINTS

1. Transverse

When transverse expansion joints are indicated on the plans, they shall be constructed at the location and in conformance with details shown in the plans or Lincoln Transportation and Utilities Standard Plans. The joint material shall extend entirely through the pavement and shall be placed so the top edge will be 3/8" below the surface of the finished pavement and curb.

During the placing and the finishing of the concrete pavement, the expansion joint material shall be held securely by means of a special holder approved by the City's Project Manager. Extreme care shall be exercised in placing concrete around the joint so the joint will remain in the true position specified herein.

After the edges have been rounded, the surface of the pavement across the joint shall be tested with a 10' straight edge placed parallel to the center line of the pavement and drawn from the center of the pavement to the edge. Any high spots or depressions shall be eliminated and the edges rounded as hereinbefore specified. Any surplus concrete at the ends of the joints shall be cut away when the forms are removed.

2. Other

Expansion material shall be formed around all objects that project through the pavement unless otherwise directed. When the pavement is placed against buildings, sidewalks and other unyielding objects, 1" expansion joint material shall be placed between the object and the new concrete.

C. CONTRACTION JOINTS OR PLANES OF WEAKNESS

Contraction joints or planes of weakness called for on the plans shall be constructed at the locations indicated and in conformance with details shown on the plans or as directed by the City's Project Manager. Maximum joint spacing shall be 15' unless otherwise directed by the City's Project Manager.

All joints shall be made with a motor driven concrete saw to a minimum depth of 1/3 the pavement thickness. The sawing shall be accomplished not later than 48 hours after concrete placement nor so soon as to cause spalling of top aggregates. When "extra strength" concrete is used, the joints shall be sawed within 24 hours after concrete placement. Transverse contraction joints generally shall be sawed within 18 hours after concrete placement. In any event, the concrete shall be sawed before random cracks develop. The sawing of any joint shall be discontinued if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw.

Any cracks that have developed in the pavement shall be routed to a depth of 1" by 3/8" in width and sealed. The joint between the curb and gutter section and concrete pavement shall be sawed to a depth of 1" and sealed.

4.06 JOINTS (Continued)

D. JOINT AND CRACK SEALING

Unless otherwise approved by the City's Project Manager, joints/cracks shall be sealed before the pavement is opened to traffic or to use by construction equipment, and as soon after completion of the sawing as is feasible. Just prior to sealing, each joint/crack shall be thoroughly cleaned of all foreign material, using approved equipment, and the joint/crack faces shall be clean and surface dry when the seal is applied.

The joint/crack shall be cleaned by high pressure compressed air or other approved methods to remove all residues. The joint/crack shall be filled from the bottom to the top without formation of voids. The top of the finished joint/crack seal shall be between 1/4" and 3/8" below the finished surface, unless shown otherwise on the plans. At the time of application of the joint/crack sealant, the joint/crack and pavement shall be dry and acceptable to the City's Project Manager. No sealant shall be placed during unsuitable weather or when the atmospheric temperature is below 50° F or when weather conditions indicate that the temperature may fall below 32° F within 24 hours.

The joint/crack sealing filler shall be melted uniformly and with constant stirring in an asphalt kettle of the double boiler design with oil being used as the heating medium. The material shall be furnished or prepared in pieces of such size and shape that the material can be melted readily to the proper pouring consistency. The Contractor shall obtain from the supplier or from the manufacturer and furnish to the City's Project Manager the manufacturer's recommendations for mixing, application and temperature restrictions. These recommendations shall be followed strictly. In no case shall the temperature exceed the maximum recommended by the manufacturer. When proper pouring consistency is attained, the joints/cracks shall be filled as shown in the plans, through the use of pressure type applicator, of a design approved by the City's Project Manager and equipped with a nozzle which will fit into the joints/cracks.

All adjoining surfaces shall be carefully protected during the joint/crack sealing operations, and any stains, marks or damage thereto, as a result of the Contractor's operations, shall be corrected in a manner satisfactory to the City's Project Manager.

4.07 CURING AND PROTECTION

A. CURING

No direct measurement or payment shall be made for curing and protection. The cost of curing and protection shall be considered subsidiary to other items of Work for which direct payment is made.

1. Curing With Liquid Membrane Curing Compound

Within 30 minutes after the concrete has been finished, the concrete surface and exposed vertical edges shall be sealed with a uniform application, no less than 1 gallon per 100 square feet, of a membrane curing compound as described previously in this chapter. This time may be adjusted by the City's Project Manager if, in his/her opinion, conditions warrant. Concrete which exceeds the allowed time between finishing and curing operations will be subject to removal and replacement.

An approved self-propelled mechanical power sprayer shall be used to apply the curing compound to the concrete pavement except that approved manual spraying equipment may be employed on narrow or variable width sections where the use of a self-propelled mechanical power sprayer is impractical, and on irregular sections of street returns and alley returns.

4.07 CURING AND PROTECTION (Continued)

A. CURING (Continued)

2. Curing With Wet Burlap

Within 30 minutes after the concrete has been finished, damp burlap shall be carefully placed on the concrete and kept moist in a manner which will not damage the pavement surface. This time may be adjusted by the City's Project Manager if, in his/her opinion, conditions warrant. Concrete which exceeds the allowed time between finishing and curing operations will be subject to removal and replacement.

The burlap shall be clean, evenly woven, free of encrusted concrete or other contaminating materials, and shall be reasonably free from cuts, tears, broken or missing yarns, and thin, open or weak places. The burlap shall be of sufficient length to cover all exposed surfaces including the vertical edges of the slab. At exposed vertical edges of the slab, earth shall be banked so that the top width of the berm shall be at least 6".

The burlap shall be kept continuously saturated with water for at least 72 hours following the placing of the concrete, except that the burlap may be temporarily removed so that joints may be sawed and filled, the surface tested, and any grinding or rubbing necessary may be accomplished. While the pavement is uncovered, it shall be kept wet by sprinkling with water. Concreting operations shall be suspended when water is not available to cure the concrete.

B. PROTECTION

The Contractor shall provide and maintain substantial barricades, warning signs, and watchmen, when required, to protect the new pavement and Work site from vandalism and property destruction.

Any concrete showing injury from vandalism shall be repaired or removed and replaced at the Contractor's expense, to the City's Project Manager's satisfaction. No heavy equipment or vehicular traffic shall be allowed on the new construction until the concrete has achieved a compressive strength of 3,000 psi. or 7 days have elapsed. A longer period of time may be required if, in the opinion of the City's Project Manager, the concrete is not of sufficient strength to support the equipment or vehicles. If no compressive strength data is available, the concrete shall remain closed to all public and/or construction vehicles and equipment for 14 days from date of placement. Any construction vehicles and/or equipment on said concrete prior to meeting these requirements shall be penalized at the rate of \$500 for each vehicle or piece of equipment per day.

4.08 INTEGRAL CURB

No direct measurement or payment shall be made for integral curb. The cost of integral curb shall be considered subsidiary to the items for which direct payment is made.

When required, integral curb shall be constructed on the edge of the concrete slab in conformance with the plans and typical cross section. The concrete for the integral curb shall be of the same mixture as used in the concrete slab.

The finish machine screed template should preferably leave enough concrete at the curb location to eliminate further carry back and handling of the concrete. The steel curb template shall be an integral part of the finish machine with a self-contained vibrator for the curb section.

4.08 INTEGRAL CURB (Continued)

When authorized by the City's Project Manager, the curb may be placed immediately after the concrete in the pavement has been placed and finished, but before the concrete develops its initial set, by means of a curb machine equipped with a steel template and self-contained vibrator. Hand placement methods shall be finished with the aid of a metal mule template. This method shall be used only where specifically authorized by the City's Project Manager.

4.09 PAVEMENT BASIS OF PAYMENT

A. GENERAL

Such payment shall be full compensation for all preparation of subgrade, forms or slip forming, curb and gutter, integral curb, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, backfilling, guarantee, cleanup and incidentals necessary to complete the Work.

Concrete placed shall be paid for per the concrete mix approved. However, concrete which does not make the minimum required strength for opening to traffic within 24 hours for Class PR or within 48 hours for Class L-5500 shall be paid for as Class L-3500 unless approved otherwise by the Engineer.

Curb drops shall be constructed at locations shown on the plans or as directed by the City's Project Manager for the future construction or reconstruction of driveways or access ramps. No direct payment will be made for the Work of constructing curb drops. The cost of curb drops shall be considered subsidiary to the items for which direct payment is made.

B. PORTLAND CEMENT CONCRETE (PCC) PAVEMENT

The pavement of the dimensions and thickness called for on the plans, constructed in conformance with the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square yard for PORTLAND CEMENT CONCRETE (PCC) PAVEMENT, ____". The final measure shall be for pavement only, excluding curb and gutter. Plain (non-reinforced) concrete pavement of the various thicknesses called for in the proposal, constructed in conformance with these Standard Specifications and accepted by the City's Project Manager.

No additional payment over the unit Contract Bid price will be made for any pavement which has an average thickness in excess of that shown on the Plans.

C. PORTLAND CEMENT CONCRETE (PCC) PAVEMENT with INTEGRAL CURB

The pavement of the dimensions and thickness called for on the plans, constructed in conformance with the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price per square yard for PCC PAVEMENT with INTEGRAL CURB, ____". The final measure shall be for pavement with integral curb and measured from back of curb to back of curb.

No additional payment over the unit Contract Bid price will be made for any pavement which has an average thickness in excess of that shown on the Plans.

4.09 BASIS OF PAYMENT (Continued)

D. REINFORCED PORTLAND CEMENT CONCRETE (RPCC) PAVEMENT

Reinforced concrete pavement of the various thicknesses called for in the proposal, constructed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square yard for REINFORCED PORTLAND CEMENT CONCRETE (RPCC) PAVEMENT, ____".

No additional payment over the unit Contract Bid price will be made for any pavement which has an average thickness in excess of that shown on the Plans.

E. CONCRETE SIDEWALK; CONCRETE DRIVEWAY; CONCRETE BIKEWAY

CONCRETE SIDEWALK, ____" THICK; CONCRETE DRIVEWAY, ____" THICK; CONCRETE BIKEWAY, ____" THICK, that has been completed in conformance with the Plans and Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per square foot. Sidewalks or bikeways constructed through future driveway locations shall be constructed to the minimum driveway thickness, and shall be measured and paid for at the appropriate unit price bid for Concrete Driveway.

F. COMBINED CURB AND GUTTER, CONCRETE BARRIER CURB, or CONCRETE MEDIAN CURB

COMBINED CURB AND GUTTER, CONCRETE BARRIER CURB, or CONCRETE MEDIAN CURB, completed in conformance with the plans and Standard Specifications and accepted by the City's Project Manager, shall be measured along the face of the curb through all inlets.

Payment shall be made at the contract unit price bid per linear foot for each type and size constructed.

G. CONCRETE HEADER

Concrete headers shall be placed at the ends of all streets and intersections when the extended street or side streets are unpaved. Concrete headers constructed in conformance with Lincoln Transportation and Utilities Standard Plans and accepted by the City's Project Manager shall be paid for at the contract unit price bid per linear foot for Install Concrete Header or Remove Concrete Header.

H. CONCRETE MEDIAN NOSE

CONCRETE MEDIAN NOSE completed in conformance with the plans and Standard Specifications and accepted by the City's Project Manager, shall be paid for at the contract unit price bid per each.

I. CONCRETE MEDIAN SURFACING, 4" THICK

CONCRETE MEDIAN SURFACING, 4" THICK, completed in conformance with the plans and Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square foot.

4.09 BASIS OF PAYMENT (Continued)

J. TACK-ON MEDIAN

TACK-ON MEDIAN, completed in conformance with the plans and Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square foot.

4.10 ALLEY PAVEMENT AND ALLEY RETURNS

A. GENERAL

The finishing of concrete alley pavement and concrete alley returns shall proceed, in general, in conformance with the methods specified above under "Hand Finishing", with the modification that after the required strike off and consolidation, the surface shall be floated longitudinally with a wooden float.

Where walls of buildings or other obstructions exist immediately adjacent to alley lines and against which the new pavement must be placed, an accepted bond breaking material will be applied between the existing building and new pavement necessary modifications of the methods specified in this section will be approved by the City's Project Manager. No essential requirements, however, relating to quality of workmanship or trueness to grade and cross sections shall be waived. In general, a temporary screed strip shall be set to the proper grade, parallel to the alley line and approximately 1' there from, and a somewhat shorter screed shall be used.

As soon as the necessary screeding has been completed, the screed strip shall be immediately removed and the space filled with fresh concrete. Final finishing shall then be completed as specified under machine finish of these Standard Specifications. All jointing, jointing patterns and typical sections shall conform to Lincoln Transportation and Utilities Standard Plans.

B. BASIS OF PAYMENT

Alley pavement of the various thicknesses called for in the proposals, constructed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square yard for PORTLAND CEMENT CONCRETE (PCC) ALLEY PAVEMENT, ____". Such payment shall be full compensation for all preparation of subgrade, forms or slip forming, curb and gutter, integral curb, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, backfilling, guarantee, cleanup and incidentals necessary to complete the Work.

4.11 CURB RAMPS

A. GENERAL

Curb ramps shall be constructed at the locations shown on the plans or as directed by the City's Project Manager. Curb ramps thickness shall be equal to the pavement thickness, but no less than 6" and no more than 10". Said thickness shall be carried out a distance measured no less than 4' and no more than 6' measured perpendicular to the back of curb. All curb ramps shall be constructed with DETECTABLE WARNING PANEL material in conformance with the Lincoln Transportation and Utilities Standard Plans.

B. BASIS OF PAYMENT

Curb ramps shall be measured and paid for at the appropriate unit price bid for CONCRETE SIDEWALK, ____" THICK or CONCRETE BIKEWAY, ____" THICK. Such payment shall be full compensation for all preparation of subgrade, forms or slip forming, curb and gutter, integral curb, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, backfilling, guarantee, cleanup and incidentals necessary to complete the Work.

DETECTABLE WARNING PANELS material shall be paid for by the square foot of material in place.

4.12 PAVEMENT REPAIR

A. GENERAL

This work shall consist of repairing Portland Cement Concrete (PCC) pavement with Portland cement concrete (PCC), Asphaltic Concrete (AC), and/or hot-applied, flexible polymer modified concrete (FPMC) at the locations shown in the contract or as designated by the Engineer. The work shall include removing deteriorated concrete, disposing of the old concrete, preparation of the repair area, and furnishing, placing, finishing and curing of the PCC, FPMC, or Asphalt. This work includes full depth and partial depth repairs for pavement, curbs, joints, and cracks. Additional details are included in Lincoln Transportation and Utilities Standard Plans.

Concrete pavement repairs are grouped into 3 types based on the surface area of the patch (see Table 4.12A).

TABLE 4.12A – PCC PAVEMENT REPAIR GROUPS

Type	Size Square Yards (SY)
A	Less than 5
B	5 to 15
C	More than 15 to 45

Repair areas exceeding 45 SY in size and not of full panel width shall also be paid as a Type C concrete pavement repair. Dowel baskets for full depth concrete pavement repairs shall be installed at transverse joints. Repair areas greater than 45 SY in size and of full panel width shall be paid for and constructed per City of Lincoln Standard Specifications for PCC pavement. Dowel baskets for PCC pavement construction shall be installed when present in existing pavement.

4.12 PAVEMENT REPAIR (Continued)

A. GENERAL (Continued)

Full depth concrete pavement repairs shall be a minimum of 4' in length and 4' in width. New curb shall be constructed as indicated on the plans or as directed by the City's Project Manager, to the same dimensions as the existing curb and measured and paid for in conformance with Chapter 4 of the current City of Lincoln Standard Specifications.

Full depth pavement repair shall be constructed on a prepared subgrade or foundation course as prescribed in the contract. The thickness of the new concrete pavement shall match the existing pavement thickness or as shown on the plans.

Removal of concrete for partial depth pavement repair shall be to the depth necessary to reach sound concrete. The minimum depth of removal shall be 1.5" for FPMC, 2" for asphalt, 3" for PCC, or as shown on the plans. The maximum depth of removal shall be 4". The minimum width of removal shall be 2' for PCC pavement or joint repairs. The minimum width of removal shall be 1' for FPMC or asphalt pavement or joint repairs. The maximum mill width for crack repairs shall be 8".

B. MATERIALS

1. CONCRETE

Repairs shall be made with Class L-3500 if the contract allows for lane closures, partial/full closure of drive access, or detours to accommodate the extended curing period. Repairs made with Class L-5500 or Class PR concrete shall be at approved locations as shown on the plans or as directed by the City's Construction Project Manager.

All concrete materials furnished by the Contractor shall conform to the requirements set forth in Chapter 3 of the current City of Lincoln Standard Specifications.

2. FLEXIBLE POLYMER MODIFIED CONCRETE

Partial depth concrete repairs constructed with flexible concrete material shall consist of hot applied, polymer modified resin compounds containing mineral fillers, chopped fiberglass fibers, and graded aggregates. The repair material shall conform to the requirements of Table 4.12B.

TABLE 4.12B – FLEXIBLE POLYMER MODIFIED CONCRETE

Property	Requirement	Test Method
Color	Gray	Visual
Specific Gravity	1.8 – 2 g/cc	ASTM D2726
Flow	3mm max @ 60C @ 5hrs	ASTM D5329, 0.5" thick specimen
Tensile Adhesion Elongation	20% min	ASTM D5329, 0.75" thick specimen @ 2"/min
Resilience	50% Recovery	Tex-547-c
Flexibility	No Tear at Bend	ASTM D3111, 1" dia., 0.4" thick, 4" wide
Application Temperature	*	
Aggregate Settlement	3% Maximum	Tex-551-c
Maximum Heating Temp	*	

*As recommended by the manufacturer

4.12 PAVEMENT REPAIR (Continued)

B. MATERIALS (Continued)

2. FLEXIBLE POLYMER MODIFIED CONCRETE (Continued)

The material shall be suitable for pavement repair depths up to 4"; it shall be durable when subjected to vehicle traffic for climate conditions normal to Nebraska. It shall set up and withstand traffic within one hour. It must be specifically designed for repair of concrete spalls or partial depth repairs. The material must be able to resist water and form a tight seal to the concrete.

The repair material is to be supplied in a powder form, factory blended and bagged in wholly meltable type containers, and any of their components, shall be fully meltable and integrational with the polymer concrete material by the time the manufacturer's minimum application temperature is reached. Material that is shipped in boxes shall not have staples. Unused material left in machine must be able to be reheated and used at least twice with no effect in the material's performance.

A manufacturer's recommended primer agent shall be used to coat the vertical and horizontal repair surface promoting adhesion and preventing moisture intrusion.

Bulking aggregate shall be as supplied by the manufacturer or shall be a hard, durable, clean, crushed rock meeting the gradation requirements of Table 4.12C and approved by the City's Project Manager.

TABLE 4.12C – BULKING AGGREGATE

Sieve	% Passing
1"	100%
3/4"	90-100%
3/8"	0-15%
No.200	0.5% maximum

Surface aggregate shall be as supplied by the manufacturer or shall be a hard, durable, clean, crushed rock meeting the gradation requirements of Table 4.12D and approved by the City's Project Manager.

TABLE 4.12D – SURFACE AGGREGATE

Sieve	% Passing
No. 4	100%
No. 10	1-10%
No. 200	0.5% maximum

3. ACCEPTANCE REQUIREMENTS

All materials used for concrete pavement repairs and joint repairs, otherwise not listed here shall conform to those requirements in the contract and or Lincoln Standard Specifications.

Flexible polymer modified concrete material and materials used in conjunction with it for repairs shall be accepted based on manufacturer's certification of compliance letters.

4.12 PAVEMENT REPAIR (Continued)

C. EQUIPMENT

1. CONCRETE EQUIPMENT

A mobile mixer conforming to the requirements set forth in Chapter 3 of the current City of Lincoln Standard Specifications may be used.

Adequate hand tools shall be provided, including an internal vibrator. Internal vibrators and hand tools shall meet the concrete placement requirements of Chapter 4 of the current City of Lincoln Standard Specifications.

Screeds, either mechanical or hand operated, shall be used to finish the concrete except for small patches and integral curb repair. The screeds shall be either a vibrating or roller type screed specifically designed for striking off concrete and in conformance with the concrete placement requirements of Chapter 4 of the current City of Lincoln Standard Specifications.

Drills for dowels or tie bars, shall be capable of drilling the appropriately sized hole parallel to the surface of the concrete and the longitudinal centerline within 1/8".

2. FLEXIBLE POLYMER MODIFIED CONCRETE EQUIPMENT

Repair material must be melted in an appropriate indirectly heated mixing unit with horizontal shaft and full sweep agitation to uniformly mix the product and with an effective product delivery system. The temperature of material shall be controlled with an electronically controlled thermostat.

The repair site shall be milled with an approved milling machine to the specified width and depth. Pot holes or spalls shall be milled, saw cut and/or removed with a 15 lb. maximum chipping hammer.

A hot compressed air lance shall be used to clean and dry the repair surfaces when moisture is present. The hot air lance shall be capable of producing temperatures in excess of 2500° F and flow rates of 185 cfm.

Adequate hand tools shall be provided.

3. ACCEPTANCE REQUIREMENTS

All equipment used for pavement repairs and joint repairs, otherwise not listed here shall conform to those requirements in the contract and or Lincoln Standard Specifications.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS

1. REMOVALS GENERAL REQUIREMENTS

The Contractor shall remove the concrete pavement and curbs, if applicable, without damaging the adjacent concrete pavement and curbs. Repair of any damage caused by the operation is at the Contractor's expense.

The Contractor shall remove and dispose of all old pavement, reinforcing steel, and all other materials. The repair section shall be removed with minimum disturbance of the underlying foundation course. Any loosened foundation course material shall be removed and replaced with concrete.

If reinforcing fabric is encountered, it shall not be replaced.

The Contractor shall cut around the perimeter of the repair area as shown in the plans. All repairs shall be cut so the edges are parallel or perpendicular to the traveled way. Saw overcuts shall be kept to a minimum.

The Contractor shall use hand or pneumatic tools to remove the concrete pavement. If the patch is full depth Type C, then a drop hammer may be used to remove the pavement.

When tie bars in longitudinal joints are damaged during concrete removal, they shall be replaced by the Contractor at no additional cost to the City with No. 5 reinforcing bars that are 18" in length. The new tie bars shall be installed into holes drilled in the existing concrete and secured in place with a non-shrink grout or epoxy on the Nebraska Department of Transportation (NDOT) Approved Products List.

2. PREPARATION

a. General

The repair sections shall be removed to the lines designated in the plans and or by the City's Project Manager, including reinforcement that interferes with the operations. The wheel-type cutter shall be operated to produce minimum disturbance of the foundation course material, with no encroachment of the cut into the concrete of the adjoining lane. The Contractor shall uniformly moisten and compact the subgrade or foundation course to the satisfaction of the Engineer.

A bond breaker shall be used as shown in the contract.

Where the repair area is not bordered by existing concrete pavement, a form shall be used as the pavement edge to provide the same surface elevation and edge alignment as the existing pavement. The form shall be supported or braced in position to prevent movement during the placement and finishing of the concrete. Forms for concrete pavement repair shall conform to the requirements of this Chapter 4 of the current City of Lincoln Standard Specifications.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS (Continued)

2. PREPARATION (Continued)

b. Preparation Full Depth with Dowels or Tie Bars

Removal shall extend across the existing joint a minimum of 2' into the adjacent panel in doweled concrete.

Dowel bars or tie bars shall be anchored into the faces of the existing concrete as designated in the contract.

The dowel bar holes shall be drilled at the same plane $\pm 1/8"$ and at the spacing shown in the contract.

The tie bar holes can be drilled independently.

The drilled holes shall be thoroughly cleaned with compressed air to remove all dust, dirt, loose material and moisture.

After cleaning and prior to dowel or tie bar insertion, an application of grout or Type IV, Grade 3 epoxy shall be made at the back of the hole. The grout or epoxy shall be from NDOT Approved Products List. Twist the dowel or tie bar one full turn during insertion to completely surround it with the grout or epoxy. The furnishing and installation of dowel and tie bars will not be paid for directly but shall be considered subsidiary to the concrete pavement or joint repair work being performed.

For the new matching transverse joints on repairs that span existing joints, the dowel baskets shall be placed parallel to the joint, and the dowel bars shall be parallel to centerline.

c. Preparation Partial Depth

For partial depth repairs, the Contractor shall cut and chip the pavement edges with a 15 pound (6.8 kg) maximum chipping hammer to form reasonably neat vertical surfaces.

The Contractor shall use a diamond blade to cut around the perimeter of the repair area.

Material shall be removed from the repair area to a depth and width necessary to provide sound pavement that will allow proper bonding and support of the repair material. The Contractor may use an approved milling machine capable of removing material to the horizontal and vertical dimensions needed. Otherwise, hand or pneumatic tools shall be used to remove the concrete pavement.

All surfaces, including the bottom, of the partial depth concrete repairs shall be free from loose concrete, sand, and other debris and shall be maintained in a dry and clean condition. Use a hot compressed air lance to clean and dry the repair surfaces for application of flexible polymer modified concrete.

All surfaces shall be cleaned and dry before the bonding agent is applied. The bonding agent shall be a Type IV, Grade 2 Epoxy Adhesive on the NDOT Approved Products List.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS (Continued)

2. PREPARATION (Continued)

c. Preparation Partial Depth (Continued)

The primer agent for flexible polymer modified concrete material utilized in partial depth repairs shall be as recommended by the manufacturer. Apply the primer agent to vertical and horizontal repair surfaces and allow to dry. The repair material shall be installed the same day the primer is applied. Do not use an open flame to dry the primer.

All preparation of partial depth pavement repairs, otherwise not provided above shall conform to those requirements in the contract and or Lincoln Standard Specifications.

3. PLACING AND FINISHING

a. Concrete

The Contractor shall furnish and place the concrete. The concrete shall be handled and consolidated so there will be no separation of the aggregate and the mortar.

An internal vibrator shall be used to consolidate the concrete.

A vibrating screed shall be used on a full depth concrete repair that is a full panel width and two or more panels in length, to finish the concrete to the final elevation.

The concrete shall be floated with a magnesium bull float and then given a drag finish with wet burlap, carpet, or canvas in a direction parallel to the traffic flow. If the surface is not to receive an overlay or smoothness grinding, it shall be finished to match the existing surface.

b. Flexible Polymer Modified Concrete

Mix and heat the repair material to a temperature as recommended by the manufacturer. Placement of the material at a temperature outside of the specified or manufacturer recommended temperature range may require removal and replacement of flexible polymer modified concrete material or concrete at the expense of the Contractor. All material heated in excess of the manufacturers maximum heating temperature for more than one hour shall be rejected.

If bulking or surface aggregate contains surface moisture, dry the aggregate by heating, aerating or other method approved by the City's Project Manager before placement in repair material.

The heated repair material shall be placed in lifts with dry bulking aggregate at a rate of 20% to 30% of the repair volume, not to exceed 30% of the entire repair volume.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS (Continued)

3. PLACING AND FINISHING (Continued)

b. Flexible Polymer Modified Concrete (Continued)

One lift of heated repair material and bulking aggregate shall be defined as the placement of repair material followed by bulking aggregate uniformly spread over entire repair area and then enclosed by repair material. The bulking aggregate shall be installed such that 50% of the bulking aggregate is encapsulated by the lower layer of repair material and the remaining 50% will be enclosed in the top layer of repair material.

One lift shall fill approximately 1.5" to 2" of a repair depth. The repair material shall always be at least 3/4" thick at the bottom of the repair. Install additional repair material and bulking aggregate in 1.5" to 2" lifts until the repair is level with the existing pavement. Each lift shall cool to 200° F prior to placing the next lift. The final 1/2" of the repair shall consist of only flexible polymer modified concrete material (no bulking stone) for optimum flexibility of repair.

Dress the surface of the repair with surface aggregate. Perform this operation while the repair is still hot. The finished surface shall be within 1/4" of existing pavement. At the discretion of the Engineer, repair areas with depressions greater than 1/4" may be repaired by reapplying the heated repair material with surface aggregate. Do not use air lance or open flame to heat the existing surface material of the depression area.

Sweep the area and remove all debris from the site.

c. Asphaltic Concrete

The Contractor shall furnish and place the asphaltic concrete conforming to those requirements in the contract and or Lincoln Standard Specifications.

4. JOINTS/CRACKS

The Contractor shall create joints in full depth repairs as shown in the contract.

When pavement and joint repairs will not be overlaid, all saw cuts, random cracks, transverse joints, and longitudinal joints shall be thoroughly cleaned with compressed air to remove all dust, dirt, loose material and moisture, and sealed with hot pour joint sealant as specified in section 4.06. D.

Joints/cracks shall not be sealed until after any corrective work or Diamond Grinding and Texturing Concrete Pavement is completed. Formed joint wells that are destroyed shall be reconstructed, and joints/cracks of insufficient depth shall be deepened prior to sealing.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS (Continued)

5. CURING AND PROTECTION

a. General Concrete

The Contractor shall apply curing compound to all concrete pavement repairs. The cure compound shall be applied immediately after each patch is completed.

When pavement and joint repairs are overlaid with asphaltic concrete, the curing method shall be with tack coat. An approved asphalt emulsion or bituminous based compound may be used with approval of the City's Project Manager.

White pigmented curing compound shall be used when the repair will be the wearing surface. The application rate shall be 1 Gallons per 100 Square Feet.

b. Class L-3500 Concrete

Class L-3500 concrete pavement repairs shall not be opened to traffic until the compressive strength reaches 3,000 psi as determined by the Maturity Method or cylinders, at the discretion of the City's Project Manager. The maturity curve will be developed by the City's Testing Lab. Concrete shall not be placed when ambient air temperature is expected to drop below 40°F (4°C) during the cure period.

c. Class PR and Class L-5500

Class PR and Class L-5500 concrete pavement repairs shall be covered with polyethylene film and then insulation board or insulated blankets immediately after the curing compound has been applied. The insulation board and insulated blankets shall have an R-value (thermal resistance) equal to or greater than 5 ft²-hr-°F/BTU [1.0 m² (°C/W)]. Insulation and polyethylene film shall be maintained until concrete reaches opening strength.

Class PR and Class L-5500 concrete pavement repairs shall not be opened to traffic until the compressive strength reaches 3000 psi. This will be determined by use of Maturity Method or cylinders, at the discretion of the City's Project Manager. The maturity curve will be developed by the City's Testing Lab.

Table 4.12E is a guide to the minimum time the PR concrete will reach a compressive strength of 3,000 psi.

TABLE 4.12E – CLASS PR (With Calcium Chloride)

Minimum Ambient Air Temperature	Hours
(41° – 60°) F (5° – 16° C)	12
(61° – 80°) F (16° – 27° C)	8
Above 80° F (27° C)	4

Concrete shall not be placed when ambient air temperatures are expected to drop below 40° F (4° C) during the cure period.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS (Continued)

5. CURING AND PROTECTION (Continued)

c. Class PR and Class L-5500 (Continued)

Class PR Concrete with calcium chloride added will be used for all concrete repairs if the repaired areas must be opened to traffic within 24 hours. Calcium chloride may be excluded from the concrete mix provided the minimum required strength can be attained within the allotted time.

Class L-5500 Concrete will be used for all concrete repairs if the repaired areas must be opened to traffic within 24 to 48 hours provided the minimum required strength can be attained within the allotted time. Non-chloride accelerators may be used to accomplish this with prior approval by the City's Project Manager.

Concrete placed shall be paid for per the concrete mix approved. However, concrete which does not make the minimum required strength for opening to traffic within 24 hours for Class PR or within 48 hours for Class L-5500 shall be paid for as Class L-3500 unless approved otherwise by the Engineer.

d. Flexible Polymer Modified Concrete

Do not allow traffic over the material until after it has cooled to the point that it does not permanently deform under pressure, as recommended by the manufacturer or as directed. As a guide, allow one hour of cure time from final placement of repair material and surface aggregate for a 2" partial repair depth. Allow an additional 1/2 hour of cure time for each inch of repair depth exceeding 2".

e. Asphaltic Concrete

All curing and protection of asphaltic concrete shall conform to those requirements in the contract and or Lincoln Standard Specifications.

4.12 PAVEMENT REPAIR (Continued)

D. CONSTRUCTION METHODS (Continued)

6. SMOOTHNESS

a. Concrete

The pavement elevation of repair areas shall be corrected in a manner that eliminates dips or bumps. Dips and bumps are defined as having a 1/8" or greater deviation using an approved 10' straightedge. If the repair will be the wearing surface, the correction shall be diamond grinding or replacement as directed by the City's Project Manager. The condition of the adjacent pavement shall be considered when evaluating the 1/8" deviation requirement.

b. Flexible Polymer Modified Concrete

Any repairs that are rejected, at the discretion of the City's Project Manager, due to unsatisfactory or improper workmanship including repairs with surface profiles that vary from the existing street profile by more than 1/4" or failures due to damage by the operation or public traffic, if opened to traffic prior to approval, shall be removed and replaced at no expense to the City.

c. Asphaltic Concrete

The smoothness of repairs shall conform to those requirements in the contract and or Lincoln Standard Specifications.

E. BASIS OF PAYMENT

1. GENERAL

Adjacent pavement repairs of varying widths which are situated such that the removals of the areas may be accomplished concurrently, shall be considered as a single repair. The total area of the adjoining areas shall be combined to determine the repair type as shown in Table 4.12A.

A joint repair shall be considered any repair that extends across the joint (regardless of width) and is 9' or less in length. Any repair that extends across a joint where the final measurement is in excess of 9' in length will be paid for as the appropriate pavement repair item, as determined by Table 4.12A.

Acceptance of L-5500 and PR concrete shall be based on the concrete attaining 4000 psi within 28 days from date of placement. This may be determined either by the maturity method or test cylinders.

Acceptance of L-3500 will be based on the 28-day compressive strength of each day's production. If the 28-day strength fails, the Contractor has the option to take 3 core samples, of the concrete in question, at no additional cost to the City. The average compressive strength of the cores will be used to determine the actual 28-day compressive strength. The cores must be taken within 35 days from the date the concrete was poured. The Engineer shall select the site where the cores will be taken and take possession of them immediately after removal from the pavement. The cores shall be delivered to the City's Testing Lab for testing.

4.12 PAVEMENT REPAIR (Continued)

E. BASIS OF PAYMENT (Continued)

1. GENERAL (Continued)

Unless stated otherwise in these specifications concrete not meeting the 28-day required strength based on cylinders or maturity method as determined by the Engineer shall be removed and replaced at no extra cost to the City. Unless stated otherwise the Engineer may evaluate the concrete's expected use and may allow it to remain in place at 50% pay.

The sealing of all random cracks or joints associated with the pavement repair will not be measured and paid for directly but shall be considered subsidiary to the joint or pavement repair work being performed.

When it is determined by the City's Project Manager that a partial depth repair needs to be changed to a full depth repair after the area has been prepared for a partial depth repair, the Contractor shall be paid for the area prepared at 50% of the unit price bid for partial depth repair in addition to the full unit price bid for the full depth repair.

Payment is full compensation for all work prescribed in this Section, including but not limited to saw cuts, removals, and reinforcement.

2. CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH FPMC

Partial depth flexible, polymer modified concrete (FPMC) pavement repair, Types A and B as determined by Table 4.12A, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard for CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH FPMC.

3. CONCRETE PAVEMENT REPAIR, TYPE A, PARTIAL DEPTH ASPHALT, TYPE 3

Partial depth Asphaltic Concrete pavement repair, Type A, as determined by Table 4.12A, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard for CONCRETE PAVEMENT REPAIR, TYPE A, PARTIAL DEPTH ASPHALT, TYPE 3.

4. CONCRETE PAVEMENT JOINT REPAIR ___, PCC

CONCRETE PAVEMENT JOINT REPAIR ___, PCC completed in conformance the Plans and Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard.

5. CONCRETE PAVEMENT REPAIR, TYPE ___, FULL DEPTH, ___ PCC

Full depth Portland Cement Concrete (PCC) pavement repair, Types A, B, and C, as determined by Table 4.12A, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard for CONCRETE PAVEMENT REPAIR, TYPE ___, FULL DEPTH ___ PCC.

4.12 PAVEMENT REPAIR (Continued)

E. BASIS OF PAYMENT (Continued)

6. CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH, ___ PCC

Partial depth Portland Cement Concrete (PCC) pavement repair, Types A and B, as determined by Table 4.12A, constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per cubic yard for CONCRETE PAVEMENT REPAIR, TYPE ___, PARTIAL DEPTH, ___ PCC.

7. JOINT SEALING

JOINT SEALING, shall be measured as the number of linear feet of joint sealing completed in place and accepted by the City. It shall be paid for at the contract unit price per linear feet for joint sealing. The width of joints may vary. It is the Contractor's responsibility to review the existing conditions prior to bidding. This price and payment shall be full compensation for all labor, equipment, tools, material and incidentals required to complete the work.

8. CRACK SEALING

CRACK SEALING, shall be measured as the number of linear feet of crack sealing completed in place and accepted by the City. It shall be paid for at the contract unit price per linear feet for crack sealing. The width of cracks may vary. It is the Contractor's responsibility to review the existing conditions prior to bidding. This price and payment shall be full compensation for all labor, equipment, tools, material, and incidentals required to complete the work.

4.13 SUBSTANTIAL COMPLETION

All projects involving items of paving shall be considered substantially complete when all items of Work shown on the proposal or called for in any other area of the Contract documents are completed to the satisfaction of the City's Project Manager. Such items shall include but will not be limited to: curb and gutter, Asphaltic Concrete pavement/Portland Cement Concrete (PCC) pavement, streets, driveways, sidewalks, alleys, bikeways, concrete curbs, medians, adjustment of manholes, valve boxes, water stop boxes, backfilling, park spacing, joint/crack sealing, and pavement markings.

Liquidated damages shall continue to accrue until such time as the Work is deemed to be substantially completed by the City's Project Manager. However, the Contractor may submit a written request to the City's Project Manager for approval to suspend such liquidated damages to allow additional time for completion of minor items of the Work, such as seeding, sodding, and survey monuments. Granting the request for additional time by the City's Project Manager shall not relieve the Contractor of the Contractor's responsibilities for completion of those items for which the suspension is requested.

4.14 PAY FACTORS

A. COMPRESSIVE STRENGTH

A pay factor will be applied to each unit as required by the Engineer and based on the compressive strength. A unit will be comprised of the concrete represented by the day's pour, not to exceed 750 linear feet.

Concrete strengths shall be based on the compressive strength of the 28-day cylinder or the maturity method at the discretion of the Engineer and subject to the pay factors in Table 4.14A.

If the compressive strength is below the required strength, the Contractor has the option to request a core sample of the concrete in question. The compressive strength of the core will be used to determine the actual 28-day compressive strength and subject to the pay factors in Table 4.14A. The core must be taken within 35 days from the date the concrete was poured. The Engineer shall select the site where the core will be taken and take possession of it immediately after removal from the pavement. The core shall be delivered to the City's Testing Lab for testing concrete strength.

If the initial core fails, two additional cores may be taken within 7 days of notification. The additional cores will be taken within 6 inches of the original core in the longitudinal direction under the direct supervision of the Engineer. The average of all three cores will be used to determine the compressive strength pay factor.

TABLE 4.14A – CONCRETE STRENGTH PAY FACTORS

Percent of Required Concrete Compressive Strength	Pay Factor
Greater than 99.7	100
Greater than 99.0 to 99.7	99.5
Greater than 98.0 to 99.0	99
Greater than 97.0 to 98.0	97
Greater than 96.0 to 97.0	95
Greater than 94.0 to 96.0	93
Greater than 92.0 to 94.0	90
Greater than 90.0 to 92.0	85
Greater than 88.0 to 90.0	80
Greater than 86.0 to 88.0	75
Greater than 85.0 to 86.0	70
85.0 or less	Remove and Replace*
*When the compressive strength of the concrete is less than 85.0% of the required strength (after 28 days), the Engineer will evaluate the concrete's expected use and may allow it to remain in place at 40% pay.	

4.14 PAY FACTORS (Continued)

B. PAVEMENT THICKNESS

A pay factor will be applied to each unit as required by the Engineer. Based on the measured thickness the pavement core will be subject to the pay factors in Table 4.14B. The Engineer shall select the site where the core will be taken and take possession of it immediately after removal from the pavement.

If required, one core will be taken from each unit consisting of not more than 300 linear feet of pavement. If deficient by more than 0.25", 2 additional cores will be taken in the same unit and averaged. If any core is deficient by more than 0.50", the limits will be determined by coring the adjacent panels parallel with centerline of the street and repeated until the pavement comes within the 0.50" tolerance. The thickness pay factor in Table 4.14B shall be applied to the representative quantity of pavement.

TABLE 4.14B – PAVEMENT THICKNESS PAY FACTORS

Average Thickness Deficiency	Pay Factor
0" to 0.25"	100
Greater than 0.25" to 0.30"	90
Greater than 0.30" to 0.35"	85
Greater than 0.35" to 0.40"	80
Greater than 0.40" to 0.45"	75
Greater than 0.45" to 0.50"	70
Greater than 0.50"	Remove and Replace*
*When the thickness of the pavement is deficient by more than 0.50", the Engineer will evaluate the pavement's expected use and may allow it to remain in place at 40% pay.	

CITY OF LINCOLN, NEBRASKA STANDARD SPECIFICATIONS

CHAPTER 5

PORTLAND CEMENT CONCRETE (PCC) BASE CONSTRUCTION

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CHAPTER 5

PORTLAND CEMENT CONCRETE (PCC) BASE CONSTRUCTION

5.00 GENERAL

This Work shall be defined as the construction of a completely new pavement structure or the reconstruction of an existing pavement structure including earthwork, appurtenances, and all related construction required to connect to existing pavement around the limits of construction.

The concrete base shall be constructed on an approved subgrade in conformance with Chapter 2 of these Standard Specifications, in conformity with the lines, grades and typical cross sections shown on the plans.

5.01 MATERIAL

A. CONCRETE

Portland Cement Concrete (PCC) for base shall be LB 2750 concrete for new construction of Residential Streets only and LB-3500 for all other applications unless otherwise specified. LB-2750 and LB-3500 concrete shall meet the requirements of Chapter 3 of these Standard Specifications. The thickness of the base shall be as shown on the plans.

B. LIQUID MEMBRANE CURING COMPOUND

Curing Compound for base construction shall be either Translucent Liquid Membrane-Forming Type or Emulsified Asphalt

1. Translucent Liquid Membrane-Forming Type

Translucent Liquid Membrane Forming Type curing compound shall contain no wax, resin or solvent and shall conform to “Standard Specifications for Liquid Membrane -Forming Compounds for Curing Concrete”, ASTM Designation C 309, Type 1, Class B. Only curing compounds included on the latest edition of the NDOT Approved Products list shall be used unless otherwise approved by the City Engineer.

2. Emulsified Asphalt

Emulsified Asphalt used as cure for concrete base shall conform to “Standard Specification for Emulsified Asphalt”, ASTM D 977. The Emulsified Asphalt shall be homogeneous after thorough mixing provided separation has not been caused by freezing. Emulsified Asphalts separated by freezing shall not be used. Only Emulsified Asphalts included on the latest edition of the NDOT Approved Products list shall be used unless otherwise approved by the City Engineer.

5.02 PREPARATION OF SUBGRADE

The subgrade shall be prepared as specified in Chapter 2 of these Standard Specifications. To prevent the absorption of moisture from the newly deposited concrete, the subgrade shall be kept moist by light applications of water until the concrete base has been placed.

No direct payment will be made for preparation of subgrade. Subgrade preparation shall be considered subsidiary to other items of Work for which direct payment is made.

5.03 FORMS

The outside form for the construction of concrete base shall be the combination curb and gutter. Alternate forms, when required, shall be steel or wood. Steel forms shall have a minimum base width of 6" and a minimum length of 10', and shall be equipped with an adequate locking device. Wood forms may be used only on curves of less than 150' radius. The depth of all forms shall be equal to at least the depth of the concrete being placed. No built-up forms will be permitted.

All forms shall be free from bends and warps at all times. They shall be cleaned thoroughly each time they are used and adequately oiled before concrete is placed against them. The forms shall be set so that they rest firmly through their entire length on thoroughly compacted subgrade. They shall be set accurately to line and grade and sufficiently braced to resist the pressure of the concrete. Forms shall be set at least 150' ahead of the paving operation.

Sufficient forms shall be provided so they may remain in place 12 hours or more after the concrete has been placed.

No direct payment will be made for forms. Form work shall be considered subsidiary to other items of Work for which direct payment is made.

5.04 CONCRETE PLACEMENT

A. GENERAL

The concrete shall be deposited uniformly on the prepared subgrades and distributed to the required depth over the entire width of the pavement by approved methods, struck off and finished as hereinafter provided. The Concrete placement operation shall be carried out in such a manner as to ensure that there will be no separation of the aggregate and the mortar.

Concrete shall be leveled, consolidated and finished within 30 minutes after being placed on the grade. A lesser time may be specified by the City's Project Manager if, in his/her opinion, conditions warrant. Concrete which will exceed the allowed time between placement on grade and finishing operations shall be subject to removal and replacement.

B. VIBRATING

All concrete shall be thoroughly consolidated by means of approved mechanical vibrators. The vibrator shall uniformly consolidate the full depth and width of the concrete without segregation. Vibrating frequency shall be within the manufacturers' Specifications and shall be verified by the Contractor.

Vibrators shall not contact side forms nor transmit vibration to finishing machines or spreaders.

Machine mounted vibrators shall be operated only when the machine to which they are attached is moving and shall not cause excessive surface water with a single passage of the machine. The vibrators shall be placed so as to allow a minimum of overlap vibration.

C. FINISHING

The concrete shall be deposited in such a manner that adequate concrete remains ahead of the screed and the finish machine so that they provide the cross section required. The concrete will then be further consolidated and finished mechanically with a power-driven machine approved by the City's Project Manager. The finish machine shall be operated over the entire width of the base and shall achieve uniform consolidation.

5.04 CONCRETE PLACEMENT (Continued)

C. FINISHING (Continued)

The finishing machine shall be kept in good repair at all times and shall operate so as to give the desired finish over the entire surface of the pavement. The forward speed of the finishing machine shall be adjusted to the average progress of the concrete production, in order that the strike off operation shall be as continuous and uninterrupted as possible.

The screed on the finish machine shall be constructed of metal and shall have sufficient strength and stiffness to retain its shape under all working conditions. The working or screeding edge shall be shaped to match the required cross section of the pavement. The screed shall be operated so that when riding on the gutter pan, which shall be used as the side forms for the base, the working edge will have an excess of concrete above grade. The contact surfaces of the wheels of the finishing machine shall be kept free from concrete and earth. Hand tools that perform the function of the finishing machine shall be immediately available for use in the event of an emergency.

The pavement shall be given its final finish by means of a wet burlap drag. The drag shall be pulled in a longitudinal direction only. The drag shall be adequately maintained so that the resultant finish shall be uniform in appearance.

All small or irregular areas shall be finished by methods approved by the City's Project Manager.

No measurement or direct payment shall be made for placing, vibrating or finishing the concrete base. These items shall be considered subsidiary to other items of Work for which direct payment is made.

5.05 JOINTS

A. CONSTRUCTION JOINTS

When placing of concrete is interrupted, for any reason, for over 1/2 hour, the concrete base shall be finished against an approved bulkhead made of at least 2" material, placed in a vertical position and extending completely across the street. Special care shall be taken to consolidate the concrete against the surface of the bulkhead. When the placing of concrete is resumed, the bulkhead shall be removed and care shall be taken not to disturb any steel or concrete placed.

B. CONTROL JOINTS

Control joints shall be placed in the concrete base both longitudinally and transversely throughout the entire length of the construction. Longitudinal joints shall be placed at approximately the 1/3 points of the slab width for pavements having a total width of 33' or less,

and at the quarter points of the slab width for pavement having a total width greater than 33' but less than or equal to 44'. Transverse control joints shall be placed at intervals of 30' and shall line up with joints in the curb or combined curb and gutter.

Control joints shall be cut to a depth of at least 1/3 of the concrete thickness by such methods that may be approved by the City's Project Manager.

5.05 JOINTS (Continued)

C. LONGITUDINAL CONSTRUCTION JOINTS

All longitudinal construction joints in concrete base shall be constructed with a metal keyway and tied to adjoining slabs with tie bars of a size and spacing as provided in the plans.

No measurement or direct payment shall be made for joint construction. The construction of joints shall be considered subsidiary to other items of Work for which direct payment is provided.

5.06 CURING AND PROTECTION

A. CURING

Curing shall be accomplished using either Liquid Membrane Curing Compound or Wet Burlap.

1. Curing With Liquid Membrane Curing Compound

Within 30 minutes after the concrete has been finished, the concrete surface shall be sealed with a uniform application of a membrane curing compound as described previously in this chapter. This time may be adjusted by the City's Project Manager if, in his/her opinion, conditions warrant. Concrete which exceeds the allowed time between finishing and curing operations will be subject to removal and replacement.

An approved self-propelled mechanical power sprayer shall be used to apply the curing compound to the concrete pavement except that approved manual spraying equipment may be employed on narrow or variable width sections where the use of a self-propelled mechanical power sprayer is impractical, and on irregular sections of street returns and alley returns. The self-propelled mechanical power sprayer shall be of sufficient width to cover the entire width of the pavement.

2. Curing With Wet Burlap

Within 30 minutes after the concrete has been finished, damp burlap shall be carefully placed on the concrete and kept moist in a manner which will not damage the pavement surface. This time may be adjusted by the City's Project Manager if, in his/her opinion, conditions warrant. Concrete which exceeds the allowed time between finishing and curing operations will be subject to removal and replacement.

The burlap shall be clean, evenly woven, free of encrusted concrete or other contaminating materials, and shall be reasonably free from cuts, tears, broken or missing yarns, and thin, open or weak places. The burlap shall be of sufficient length to cover all exposed surfaces.

The burlap shall be kept continuously saturated with water for at least 72 hours following the placing of the concrete or until an asphalt tack coat is applied.

B. PROTECTION

The Contractor shall provide and maintain substantial barricades, warning signs, flares and, when required, watchmen to protect the new pavement and Work site from vandalism and property destruction.

Any concrete showing injury from vandalism shall be repaired or removed and replaced at the Contractor's expense and to the City's Project Manager's satisfaction. No heavy equipment,

5.06 CURING AND PROTECTION (Continued)

B. PROTECTION (Continued)

placement of asphalt or vehicular traffic shall be allowed on the new construction until the concrete has achieved a compressive strength of 2500 p.s.i. or 7 days have elapsed from date of placement. A longer period of time may be required if, in the opinion of the City's Project Manager, the concrete is not of sufficient strength to support the equipment or vehicles.

No measurement or direct payment shall be made for curing and protection. Those items shall be considered subsidiary to other items of Work for which direct payment is made.

5.07 BASIS OF PAYMENT

The Portland Cement Concrete (PCC) base shall be measured and paid for at the contract unit price bid, per square yard for CONCRETE BASE, ____" for each thickness identified in the plans. Such payment shall be full compensation for subgrade preparation, forms if required, curing, jointing, materials, equipment, tools, labor, and incidentals necessary to construct and prepare the base to receive the asphaltic concrete surface course. No measurement or payment shall be made for base removed for the convenience of the Contractor which, in the opinion of the City's Project Manager, would not have had to be removed to perform the Work.

5.08 CONCRETE HEADER

Concrete headers shall be as provided for in Chapter 4 of these Standard Specifications.

5.09 HOT/COLD WEATHER CONSTRUCTION

Concrete construction in hot or cold weather shall be as provided for in Chapter 3 of these Standard Specifications.

5.10 PAY FACTORS

The Portland Cement Concrete (PCC) base shall be subject to the pay factors provided for in Chapter 4.14 of these Standard Specifications.

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CHAPTER 6

ASPHALTIC CONCRETE CONSTRUCTION

6.00 GENERAL

This Work shall be defined as the construction of a completely new pavement structure or reconstruction of an existing pavement including earthwork, appurtenances, and all related construction required to connect to existing pavement around the limits of construction.

Patching shall be defined as pavement replacement of areas requiring small quantities of asphaltic concrete per placement such as utility crossing repair or larger quantity placements such as longitudinal cuts for utility work not requiring curb to curb asphalt replacement, and for other similar situations.

Asphaltic Concrete Pavement shall be defined as Class 1, an asphaltic concrete wearing surface placed on a Portland Cement Concrete (PCC) base or Class 2, an asphaltic concrete wearing surface placed on an asphaltic concrete base. The pavement structure shall be designed in conformance with Lincoln Standard Plans. The wearing surface and asphaltic concrete base shall be of a type or types of asphaltic concrete as shown on the plans and which meet the Mix Design and Aggregate Criteria requirements described below unless otherwise specified.

The thickness of the wearing surface or overlay shall be as shown on the plans or approved by the City's Project Manager. The base shall be of a thickness as shown on the plans. Lift thickness of the first asphaltic concrete base lift shall be between 3" and 5" after compaction to required density. All subsequent asphaltic concrete base lifts shall be between 1 1/2" and 3" in thickness after compaction to required density. PCC base shall meet the requirements of Chapters 3 and 5 of these Standard Specifications.

Asphaltic Concrete shall consist of an intimate mixture of naturally occurring mineral aggregates of required gradations and asphalt binder content as hereinafter specified. Unless otherwise specified or approved by the City Engineer, neither industrial nor manufacturing byproducts will be allowed in the mixture. Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS) shall be allowed as described later in these Standard Specifications.

Asphaltic Concrete mixtures shall be classified as:

- Type 1 - for use as surface course on arterial streets
- Type 2 - for use as surface course on non-arterial streets
- Type 3 - for use as surface and base on streets, parking lots, temporary pavement, and patching
- Type 4 - for use as thin lift course when directed by the City Engineer

The factor of 141 pounds per cubic foot shall be used to compute asphaltic concrete quantities of all types for design purposes.

6.01 MATERIALS

A. ASPHALT BINDER

The suppliers for asphalt binder used in City of Lincoln projects shall be certified by the Nebraska Department of Transportation (NDOT) to supply Performance Graded Binder in Nebraska.

The asphalt binder for all mixes shall conform to the requirements of AASHTO M 320 or AASHTO M 332 for Performance Graded Asphalt Binder and must meet all requirements for use on NDOT projects. The PG Binder shall meet or exceed both the upper and lower temperature targets of the PG Binder grades as shown in Table 6.02 A of these Standard Specifications unless directed otherwise by the City Engineer.

In addition, unless otherwise specified or directed by the City Engineer, the PG Binder shall be a binder which incorporates a blend of base asphalt and elastomeric modifiers of styrene-butadiene (SB), styrene-butadiene-styrene (SBS) or styrene-butadiene-rubber (SBR).

The composite material shall be thoroughly blended at the asphalt refinery or terminal prior to being loaded into the transport vehicle. The polymer modified binder shall be heat and storage stable and shall not separate when handled and stored per the supplier's storage and handling recommendations.

A Material Certification from the PG Binder Supplier shall be submitted prior to construction. The Material Certification must state that acid has not been used. The Material Certification must also state that the material has not been air blown or oxidized.

If, based on moisture susceptibility test results, the Contractor elects to use a City Engineer approved anti-stripping additive in the mix, it shall be added to the binder by the PG Binder Supplier at the rate which will result in a minimum TSR value of 80 in the mix and shall be subsidiary to the bid price of the asphaltic concrete. The type and percentage of additive shall be shown on the material certification accompanying the binder delivered to the plant.

B. TACK COATS

1. Rapid-Curing Cut-Back Asphalts

The rapid curing cut back asphalts to be used as tack coats shall conform to the requirements of AASHTO M 81, Cut Back Asphalt (Rapid Curing Type).

This Specification covers liquid petroleum products, produced by fluxing an asphaltic base with suitable petroleum distillates.

2. Emulsified Asphalts

Emulsified asphalts shall conform to the following Specifications:

ASTM D977	-	Standard Spec. for Emulsified Asphalts
ASTM D2397	-	Standard Spec. for Cationic Emulsified Asphalts
ASTM D140	-	Standard Practice for Sampling Bituminous Materials
ASTM D244	-	Standard Testing Emulsified Asphalts

Emulsified asphalts covered by these Standard Specifications shall be diluted in the distributor with sufficient potable water to reduce the asphalt residue in the mixture to approximately 30%. Emulsified asphalt shall be homogeneous within 30 days after delivery. If separation of the emulsified asphalt has not been caused by freezing, thorough mixing shall be used to achieve a homogeneous mixture.

6.01 MATERIALS (Continued)

C. MINERAL AGGREGATES

1. General

Mineral aggregates for asphaltic concrete shall conform to the following requirements except where modified herein:

- ASTM D692 - Standard Specification for Coarse Aggregate for Bituminous Paving Mixture
- ASTM D1073 - Standard Specification for Fine Aggregate for Bituminous Paving Mixture
- ASTM D242 - Standard Specification for Mineral Filler for Bituminous Paving Mixture

Mineral aggregates shall be crushed rock, broken stone, crushed gravel, sand-gravel, coarse sand, fine sand or a mixture of these materials composed of clean, hard, durable, and non-coated particles, free from injurious quantities of clay, dust, soft or flaky particles, loams, shale, alkali, organic matter, or other deleterious material. Chat or coal sand will not be allowed in any mix.

Crushed rock shall be crushed limestone, granite, quartzite, or other ledge rock approved for the intended purpose by the City Engineer and shall not contain deleterious substances in a quantity exceeding 3.5% of any combination of shale, clay lumps, coal, or soft particles with shale and clay lumps not to exceed one and 1.5%.

The absorption of water by crushed rock for use in asphaltic concrete shall not exceed 3.2% by weight.

The mineral aggregate from different sources of supply shall not be mixed or stored in the same pile, nor used alternately in the same class of construction or mixed without permission from the City's Project Manager. All fractions of a crushed rock gradation shall be produced from the same type of material.

The chemical and physical characteristics of the fraction passing the #4 sieve shall be substantially the same as those of the material which may be produced in the laboratory from the fraction which is retained on the #4 sieve.

Mineral aggregates shall have a soundness loss of not more than 12% by weight at the end of 5 cycles using sodium sulfate solution.

Mineral aggregates shall be tested prior to use and shall conform to the above requirements based on the following test designations.

- ASTM C127 - Specific Gravity & Absorption of Coarse Aggregates
- ASTM D75 - Standard Practice for Sampling Aggregates
- ASTM C136 - Standard Test Method for Sieve Analysis of Fine & Coarse Aggregates
- ASTM D546 - Standard Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
- ASTM C128 - Specific Gravity & Absorption of Fine Aggregates
- ASTM C131 - Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion Impact in the Los Angeles Machine

6.01 MATERIALS (Continued)

C. MINERAL AGGREGATES (Continued)

1. General (Continued)

- ASTM C88 - Standard Test Method for Soundness of Aggregate
- ASTM D693 - Standard Spec. for Crushed Aggregate for Macadam Pavements

2. Mineral Fillers

Mineral filler shall consist of pulverized soil, pulverized crushed rock, broken stone, gravel, sand-gravel, sand, or a mixture of these materials that conforms to the following requirements:

TABLE 6.01A – MINERAL FILLER REQUIREMENTS

Criteria	Minimum	Maximum
Total Percent Passing the #50 (300 µm) Sieve	95	100
Total Percent Passing the #200 (75 µm) Sieve	80	100
Plasticity Index non-soil material passing #200 (75 µm)	0	3
Plasticity Index for Soil	0	6

D. RECLAIMED ASPHALT PAVEMENT (RAP)

Reclaimed Asphalt Pavement (RAP) may come from the job site or the Contractor's stockpile. In either case, the Contractor will be responsible for quality and for testing the RAP prior to use. Tests shall include at a minimum, AC content and gradation. Test results shall be reported to the City's Project Manager for approval prior to use.

E. RECYCLED ASPHALT SHINGLES (RAS)

Recycled Asphalt Shingles (RAS) may be used in Asphaltic Concrete and must meet Nebraska Department of Transportation (NDOT) requirements.

F. NON-WOVEN PAVEMENT OVERLAY FABRIC

Non-woven overlay fabric shall be furnished by an ISO approved manufacturer of polypropylene or polyester geo-synthetic fabric and shall be needle punched and heat treated on one side, recyclable, millable, and shall conform to the following requirements:

TABLE 6.01B – NON-WOVEN PAVEMENT OVERLAY FABRIC

PROPERTY	MINIMUM	ASTM
Mass, oz./sq. yd.	4.1	D 5261
Tensile Strength, lb.	90	D 4632
Elongation at Break, %	>25%	D 4632
Melting Point	320° F	D 276
Asphalt Retention, gal./sq. yd.	0.2	D 6140

Acceptance shall be based upon manufacturer's certification of conformity.

6.02 ASPHALTIC CONCRETE MIXTURES

A. GENERAL

Asphaltic concrete mixtures shall be designed by the Contractor to meet the Mix Design Criteria for the appropriate mix types as shown in these Standard Specifications.

Unless otherwise specified or approved by the City Engineer, Asphaltic Concrete for Type 1 Mix shall meet or exceed all of the requirements for “Superpave-SPH” as described in these Standard Specifications.

Unless otherwise specified or approved by the City Engineer, Asphaltic Concrete for Mix Types 2 and 3 shall meet or exceed all of the requirements for “Superpave-SPR” as described in these Standard Specifications.

Unless otherwise specified or approved by the City Engineer, Asphaltic Concrete for Mix Type 4 shall meet or exceed all of the requirements for “Superpave-SLX” as described in these Standard Specifications.

TABLE 6.02A – ASPHALTIC CONCRETE MIX REQUIREMENTS SUMMARY

Type (Use)	* Mix Requirements	AC Grade M320 M332	Aggregate Blend		
			% RAP	Virgin Agg.	Gradation Requirements
1 Surface Course Arterial Streets	SPH (Superpave) 5.3% @ 1/2" 5.5% @ 3/8" Min. AC by weight of mix	PG 70-34 PG 58E-34	25% Max	Limestone 90% Max.	1/2"(0.500) Band Or 3/8"(0.375) Band (Superpave)
2 Surface Course Non- Arterial Streets	SPR (Superpave) 5.2% Min. AC by weight of mix	PG 64-34 PG 58V-34	35% Max	Limestone 95% Max.	SPR Band (Superpave)
** 3 Surface and Base Lifts, Parking Lots, Temporary Pavement, and Patching	SPR (Superpave) 5.2% Min. AC by weight of mix	PG 64-34 PG 58V-34	50% Max	Limestone 95% Max.	SPR Band (Superpave)
4 Thin Lift	SLX (Superpave) 5.5% Min. AC by weight of mix	*** PG 64-34 PG 58V-34	20% Min 35% Max	**** Crushed Rock Chips 20% Min.	SLX Band (Superpave)

* % AC shall be determined by ignition oven results.

** Type 3 mixtures will not require mix design verification testing by the City but Contractor’s mix design data must be approved by the City Engineer prior to use.

*** 0.7% of an approved amine-base WMA additive.

***** Min. 45% Retained on #4 sieve/ Max 5% passing #200 sieve.

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)

B. SUPERPAVE VOLUMETRIC MIX DESIGN

The Contractor will be required to define properties using a gyratory compactor that has met the Superpave evaluation test procedures, according to the gyration levels indicated for the mix type specified.

The mix formula shall be determined by the Contractor from a mix design for each mixture. A volumetric mixture design in conformance with the latest edition of the Asphalt Institute Publication, SP-2 will be required. However, the mixture for the Superpave specimens and maximum specific gravity mixture shall be short-term aged for two hours. Mixing and compaction temperatures shall be in conformance with the latest NDOT specifications.

The following test procedures shall apply:

AASHTO R 30	-	Practice for Short and Long-Term aging of Hot Mix Asphalt
AASHTO R 35	-	Superpave Volumetric Design For Hot Mix Asphalt (HMA)
AASHTO T 84	-	Specific Gravity and Absorption of Fine Aggregate
AASHTO T 85	-	Specific Gravity and Absorption of Coarse Aggregate
AASHTO PP 19	-	Practice for Volumetric Analysis of Compacted Hot Mix Asphalt
AASHTO T 312	-	Method for Preparing and Determining the Density of Hot Mix Asphalt Specimens by Means of the Superpave Gyratory Compactor
AASHTO T 209	-	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
AASHTO T 283	-	Resistance of Compacted Bituminous Mixture to Moisture induced Damage

The optimum binder content shall be the binder content that produces required air voids, at Ndes, in the plant produced mix. The design shall have at least four points, including a minimum of two points above and one point below the optimum. The amount of un-compacted mixture shall be determined in conformance with AASHTO T 209.

Each Superpave mixture shall be tested by the Contractor for moisture susceptibility in conformance with AASHTO T 283. The loose mixture shall be short-term aged for 2 hours in conformance with AASHTO R30. The 6" specimens shall be compacted in conformance with AASHTO T 312 to 7% air voids at 95-mm in height and evaluated to determine if the minimum Tensile Strength Ratio (TSR) of 80% has been met. If the mixture has not met the minimum TSR value, the Contractor shall have the option of modifying the mixture, as approved by the City Engineer, and retesting to verify that the minimum TSR of 80% has been achieved or by having an approved liquid anti-stripping additive added to the PG Binder, by the PG Binder Supplier, at a dosage rate, such that the mix will meet the minimum TSR of 80%.

All data shall be submitted with the mix design for approval. During production, the Contractor may be required by the City's Project Manager, to provide and test additional specimens of the plant produced asphaltic concrete for moisture susceptibility. A TSR test result of less than 80% will require mixture modification(s) and a sample from subsequent lots will be tested by the Contractor until a TSR value of at least 80% is achieved.

Changes in the types or sources of aggregates or binder may require a new job mix formula, mix design, and moisture susceptibility test. If required, the new proposed job mix formula shall be in conformance with the requirements as stated above and submitted 5 working days prior to use for approval.

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)

B. SUPERPAVE VOLUMETRIC MIX DESIGN (Continued)

1. MATERIALS SAMPLING AND TESTING

At the beginning of each year and at least 14 days before production of asphaltic concrete, the Contractor shall submit, in writing, a tentative job mix formula and material samples as described below, for approval, to the City Engineer. The job mix formula shall identify the mineral aggregates and mineral filler, if needed, with the value of the percent passing each specified sieve for the individual and blended materials.

A 65-pound bag of each of the individual mineral aggregates and RAP, if used, shall also be submitted to the City Engineer at this time. Each sample shall be marked to clearly indicate the type of material, name of the producer, and the pit location.

The Contractor shall submit, to the City Engineer, three proportioned 10,000-gram samples of the blended aggregates and a 1-gallon sample of the asphalt binder to be used in the mixture. Whenever RAP is used, it shall be processed through an ignition oven and then combined proportionally with the virgin aggregate in one of the 10,000-gram samples. The remaining two 10,000-gram samples shall be made up of the unprocessed RAP combined proportionally with the virgin aggregate. Submitted with these samples shall be a copy of the mix design values obtained from tests performed by the Contractor. This mix design shall include at a minimum, the following information:

- The bulk specific gravity (Gsb) of the blended aggregate (The specific gravity shall be determined for the combined blend from the unwashed portion of the - #4 and the + #4 material in conformance with AASHTO T 84 & T 85 respectively)
- The target asphalt binder content by total mix
- The supplier, grade, and specific gravity of the PG Binder
- The maximum specific gravity of the combined mixture (Rice)
- The average bulk specific gravity and air voids at N initial (Nini), N design (Ndes), and N maximum (Nmax) of the compacted gyratory specimens
- Voids in the Mineral Aggregate (VMA) and Voids filled with Asphalt (VFA) at Ndes
- Fine Aggregate Angularity (FAA), Coarse Aggregate Angularity (CAA), Flat and Elongated Particles and Clay Content of the aggregate blend

2. MIX DESIGN CRITERIA

The design criteria for each mixture shall be determined from the following Tables.

The optimum binder content shall be the binder content that produces 4.0% air voids at Ndes for SPH mixes and 3.0% at Ndes for SPR and SLX mixes in the plant produced mix. Binder content shall be determined by ignition oven.

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)**B. SUPERPAVE VOLUMETRIC MIX DESIGN (Continued)****2. MIX DESIGN CRITERIA (Continued)****TABLE 6.02B – MINIMUM BINDER REQUIREMENTS**

Mix Type	Minimum Binder Content (% by wt. of mix)
SPH	5.3% @ 1/2" and 5.5% @ 3/8"
SPR	5.2%
SLX	5.5%

TABLE 6.02C – GYRATORY COMPACTION EFFORT

Asphaltic Concrete Type	Nini	Ndes	Nmax
SPH	8	95	150
SPR	7	65	100
SLX		50	

Average Design High Air Temperature = <39° C (102° F)

TABLE 6.02D – GYRATORY COMPACTION TEMPERATURE

Mix Type	% RAP	COMPACTION TEMP. ° F
SPH	0-35	300 ± 5
SPR	0-35	280 ± 5
	36-50	290 ± 5
SLX	20-35	280 ± 5

TABLE 6.02E – VOIDS IN MINERAL AGGREGATE*

Nominal Maximum Aggregate Size	Recommended VMA, Percent (Criteria at Ndes)
SPH	14.0
SPR	12.0
SLX	16.0

*For Design purposes only

TABLE 6.02F – VOIDS FILLED WITH ASPHALT*

Asphaltic Concrete Type	Recommended VFA, Percent
SPH	65 - 75
SPR	70 - 80
SLX	N/A

*For Design purposes only

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)

B. SUPERPAVE VOLUMETRIC MIX DESIGN (Continued)

3. AGGREGATE BLEND CRITERIA

a. Coarse Aggregate Angularity (CAA)

The coarse aggregate angularity value of the blended aggregate material shall meet or exceed the minimum values for the appropriate asphaltic concrete type shown in Table 6.02 G.

TABLE 6.02G – COARSE AGGREGATE ANGULARITY (ASTM D5821)

Asphaltic Concrete Type	CAA (minimum)
SPH	95/90*
SPR	83
SLX	N/A

*Denotes two faced crushed requirements

Aggregate obtained from the residue of the ignition process shall not be used for the determination of CAA for mix design approval except when RAP material is specified and must be combined with the proportioned amount of virgin aggregate as defined by the mix design.

b. Fine Aggregate Angularity (FAA)

The fine aggregate angularity value of the blended aggregate material shall meet or exceed the minimum values for the appropriate asphaltic concrete type shown in Table 6.02 H.

The specific gravity for calculation of the FAA shall be based on a combined aggregate sample of material passing the No. 8 sieve and retained on the No. 100 sieve.

TABLE 6.02H – FINE AGGREGATE ANGULARITY (AASHTO T304 METHOD A)

Asphaltic Concrete Type	FAA (minimum)
SPH	45.0
SPR	43.0
SLX	43.0

Aggregate obtained from the residue of the ignition process shall not be used for the determination of FAA for mix design approval except when RAP material is specified and must be combined with the proportioned amount of virgin aggregate as defined by the mix design.

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)

B. SUPERPAVE VOLUMETRIC MIX DESIGN (Continued)

3. AGGREGATE BLEND CRITERIA (Continued)

c. Flat and Elongated Particles

The coarse aggregate shall not contain flat and elongated particles exceeding the maximum value for the appropriate asphaltic concrete type shown in Table 6.02 I.

TABLE 6.02I – FLAT AND ELONGATED PARTICLES* (ASTM D4791)

Asphaltic Concrete Type	Percent, Maximum
SPH	10
SPR	10
SLX	10

*Criterion based on a 5:1 maximum to minimum ratio

d. Clay Content

The Clay Content of the blended aggregate material shall be such that the Sand Equivalent Minimum value for the appropriate asphaltic concrete type as shown in Table 6.02 J shall be met or exceeded.

TABLE 6.02J – SAND EQUIVALENT CRITERIA (AASHTO T176)

Asphaltic Concrete Type	Sand Equivalent, Minimum
SPH	45
SPR	45
SLX	45

e. Gradation

The blended aggregate shall conform to the gradation requirements specified below for the appropriate nominal size.

The dust to binder ratio is the ratio of the percentage by weight of aggregate finer than the No. 200 sieve to the asphalt content expressed as a percent by weight of total mix. The dust to binder ratio shall be between 0.7 and 1.7. This shall be verified during mix design approval and production sample testing.

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)**B. SUPERPAVE VOLUMETRIC MIX DESIGN (Continued)****3. AGGREGATE BLEND CRITERIA (Continued)****e. Gradation (Continued)****TABLE 6.02K – GRADATION CONTROL POINTS FOR SPH**

Sieve	Control Points 0.500 Inch (% Passing)		Control Points 0.375 Inch (% Passing)	
	Minimum	Maximum	Minimum	Maximum
3/4 inch	100.0			
1/2 inch	90.0	100.0	100.0	
3/8 inch		90.0	90.0	100.0
No. 8	28.0	58.0	32.0	67.0
No. 16				
No. 30				
No. 50				
No. 200	2.0	10.0	2.0	10.0

TABLE 6.02L – GRADATION CONTROL POINTS FOR SPR

Sieve	Control Points (% Passing)	
	Minimum	Maximum
1/2 inch	100.0	
3/8 inch	81.0	96.0
No. 8	46.0	56.0
No. 50	12.0	21.0
No. 200	4.0	9.0

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)

B. SUPERPAVE VOLUMETRIC MIX DESIGN (Continued)

3. AGGREGATE BLEND CRITERIA (Continued)

e. Gradation (Continued)

TABLE 6.02M – GRADATION CONTROL POINTS FOR SLX

Sieve	Control Points (% Passing)	
	Minimum	Maximum
1/2 inch	98.0	100.0
3/8 inch	93.0	100.0
No. 4	70.0	87.0
No. 8	45.0	65.0
No. 16	25.0	41.0
No. 30	15.0	31.0
No. 50	10.0	21.0
No. 200	4.0	10.0

C. PRODUCTION SAMPLING AND TESTING

During production, asphaltic concrete shall be sampled and tested for acceptance by the City's Materials Lab on a lot basis. A minimum of one sample shall be required for each lot of asphaltic concrete. A lot is defined as each 500 tons or fraction thereof of each day's production. The location of the required samples shall be determined by the City's Project Manager.

Tests shall include the following:

AASHTO T209	-	Maximum specific gravity of the mix (Rice)
ASTM C136	-	Standard Test Method for Sieve analysis of Fine and Coarse Aggregate
AASHTO T312	-	Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
AASHTO T166	-	Bulk Specific Gravity of compacted Bituminous Mixtures using saturated surface-dry specimens
AASHTO T308	-	Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the ignition method

6.02 ASPHALTIC CONCRETE MIXTURES (Continued)

C. PRODUCTION SAMPLING AND TESTING (Continued)

TABLE 6.02N – ASPHALTIC CONCRETE PRODUCTION TOLERANCES

Test	Mix Type		
	SPH	SPR	SLX
AC(None)	5.3% @ 1/2" Min, 5.5% @ 3/8" Min.	5.2% Min.	5.5% Min.
Air Voids	4% (+/- 1%)	3% (+/- 1%)	3% (+/- 1%)
FAA (cold feed)	45 Min. (-0.50)	43 Min. (-0.20)	43 Min. (-0.20)
FAA (ignition oven)	45 Min (-1.00)	43 Min. (-0.50)	43 Min. (-0.50)

If at the end of the day's production, the tolerances in Table 6.02 N are exceeded, the Contractor will not be allowed to resume production until corrective adjustments are made to the mix design.

Mix adjustments at the plant are authorized within the limits shown in Table 6.02 O without redesigning the initially approved mix.

The adjustment must produce a mix with the percent air voids and all other properties as stated in these Standard Specifications.

All adjustments must be reported to the City Engineer.

The adjustment values in Table 6.02 O will be the tolerances allowed for changes indicated by production or mix design test results, but cannot deviate from Superpave gradation criteria.

Mix adjustments for individual aggregates, including RAP, greater than 25% of the original verified mix design proportion or greater than 5% change in the original verified mix design percentage, whichever is greater, may require the Contractor to submit a new mix design, as determined by the City Engineer. The Contractor is responsible for requesting new mix design targets as they approach these tolerances, failure to do so may result in a suspension of operations until a new mix design is approved.

TABLE 6.02O – AGGREGATE ADJUSTMENT TOLERANCE

Aggregate Adjustments	
Sieve Size	Adjustment Range
1", 3/4", 1/2", 3/8", No. 4	± 6%
No. 8, No. 16, No. 30, No. 50	± 4%
No. 200	± 2%

6.03 EQUIPMENT

A. GENERAL

All equipment, tools and machinery shall be adequate for the purpose for which it is to be used, and shall be maintained in satisfactory working condition at all times. The equipment shall be at the Work site sufficiently in advance of construction operations to be thoroughly examined and approved by the City's Project Manager. The Contractor shall furnish the necessary accessories, equipment data, and assistance required by the City's Project Manager for making tests and calibrations on equipment.

The Contractor shall furnish the necessary accessories and personnel and shall perform calibrations on the equipment. Copies of the calibration data shall be provided to the City's Project Manager before production of Asphaltic Concrete. In the event problems are encountered during the calibrations, the Contractor shall arrange for a trained technician or company representative of the company from which the equipment was obtained to make the necessary repairs and/or adjustments to the equipment. Calibrations shall be made as often as is deemed necessary by the City's Project Manager to ensure accuracy of the equipment.

In the event that a Contractor elects to obtain asphaltic concrete from a commercial plant not under his direct control, he shall reach agreement with the commercial producer to perform the above functions in the same manner as though the plant was under his direct control. The Contractor shall also reach agreement with the producer to furnish or shall arrange to have furnished an approved building for use by the City Engineer if deemed necessary by the City's Project Manager.

B. MIXING PLANT

1. General

The equipment that is used for heating, proportioning, and mixing the aggregates and asphalt cement shall be able to produce a uniform mixture.

The dryers shall be able to dry and heat all aggregates to the required temperatures with positive control. Aggregates shall be agitated continuously during the process of heating. Damage to the asphalt cement in dryer-drum type mixing plants shall be avoided.

Salvaged bituminous material shall not be exposed to open flame.

Continuous temperature and time readings of the asphaltic materials shall be electronically recorded whenever the plant is operated. A copy of the temperature reading shall be made available to the City's Project Manager. Temperature and time displays shall be easily accessible. Temperature and time sensors will be provided at the following locations:

- a. Inside the asphaltic concrete mixture discharge chute.
- b. Inside the surge bin.
- c. Inside the asphalt cement storage tank.

During storage, the asphalt cement temperature shall be maintained between 250° F and 350° F or at the storage temperature range recommended by the binder supplier. All plants shall be equipped with a circulating system for asphalt cement which is designed to assure proper and continuous circulation during the operating period. Storage tanks shall have sufficient capacity to provide for continuous operation. The tanks shall be situated and constructed to allow the volume of the asphalt cement to be safely and accurately determined at any time.

6.03 EQUIPMENT (Continued)

B. MIXING PLANT (Continued)

1. General (Continued)

If the plant is equipped with a surge bin for the temporary storage of asphaltic concrete, the asphaltic concrete taken from the surge bin will not differ significantly from the material taken directly from the plant. The first material entering the bin will be the first material removed. The surge bin shall be completely emptied at the end of each operating day unless insulated or heated.

All plants shall be equipped with a continuously operated dust collector. The collected material may be wasted or returned to the mix.

Mineral filler bins shall be protected from moisture.

2. Pug-mill Plants

a. General

Pug-mill plants shall include cold aggregate feeders, oversize screens, storage bins for dried aggregate, ingredient proportioning devices, and all other equipment necessary to produce the specified mixture. The pug-mill blades shall have a minimum clearance of 3/4" from all fixed and moving parts. The mixer shall be equipped with a discharge hopper holding approximately 1 ton of hot mixture and capable of intermittent discharge.

b. Batch Plants

Batch plants shall have an accurate time lock to control the operations during a complete mixing cycle. They shall lock the scale box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. They shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

The dry mixing period is defined as the time between the opening of the scale box gate and the addition of bituminous material. The wet mixing period is the interval of time between the addition of bituminous material and the opening of the mixer gate.

The control of the timing shall be flexible and capable of being set at 5-second intervals or less throughout a total cycle of not less than 3 minutes. A mechanical batch counter shall be installed as a part of the timing device and shall be designed and constructed to register only upon the release of the bituminous material. It shall not register any dry batches or any material wasted through the bins. The timing device shall have a suitable case with a locking door that shall always be kept closed and locked except when adjustments or repairs are required.

All batch plants shall be equipped with an asphalt cement volume meter or a heated or insulated asphalt bucket with scales.

Scale hoppers and scales for proportioning aggregates and asphalt to the batch plant's mixer shall be accurate within 0.5%; and they shall be sensitive within 0.2% or 2 pounds, whichever is greater, throughout the range of use.

6.03 EQUIPMENT (Continued)

B. MIXING PLANT (Continued)

2. Pug-mill Plants (Continued)

c. Continuous Type

Plants shall be equipped with a pump synchronized to the feeding mechanism so that the required percentage of asphalt cement is applied continuously and uniformly. The feeding system shall be synchronized to the rest of the plant.

3. Dryer-Drum Plants

These plants shall include cold aggregate feeders, vibratory screening units for removing oversize material from both virgin and reclaimed material, proportioning devices for controlling the quantity of each ingredient in the mixture, and any other equipment necessary to produce the mixture as specified.

Plants shall be equipped with a pump synchronized to the feeding mechanism so that the required percentage of asphalt cement is applied continuously and uniformly. The feeding system shall be synchronized to the rest of the plant.

C. TRUCK SCALES

Truck scales shall be furnished by the Contractor for weighing loaded trucks at the plant site, and shall be installed on adequate foundations and in conformance with the manufacturer's recommendations. The scales shall have sufficient capacity to weigh the maximum axle, combination of axles or gross load used and shall be accurate to 0.5% of the total axle load or total load.

Scales shall be properly calibrated by the Contractor in the presence of the City's Project Manager unless the scales have current Nebraska Department of Agriculture inspection approval or unless calibration and adjustment by a recognized scale company service crew has been performed during the current season, and attested to by the City's Project Manager. The scales shall be periodically cross checked for accuracy during the course of the Work by checking the net weight of loads of the material being produced on commercial scales in the vicinity of the project which have current agriculture inspection approval. The Contractor shall furnish at least (10) 50-pound weights for checking the accuracy of the scales. If the scale is not capable of weighing all axles at one time, the approaches shall be extended so the entire hauling unit will be level during weighing. Chuck holes, ruts or high spots in the approaches which develop during hauling operations shall be immediately repaired as directed by the City's Project Manager.

All weighing shall be done with the hauling unit stationary, level, and out of gear. Suitable protection shall be provided against wind currents that may affect the accuracy of the scales. The platform of the scale shall be kept clean and free from accumulations of materials, as directed by the City's Project Manager.

Serially numbered duplicated scale tickets shall be furnished to accompany each truck load of material to the unloading point. Scale tickets shall reflect the date, time, load number, total weight, tare weight, project number, mix type, destination, and net weight.

6.03 EQUIPMENT (Continued)

D. DISTRIBUTORS

Whenever the use of a distributor is required, that piece of equipment shall be manufactured expressly for the purpose of applying heated asphaltic materials by pressure spray applications. Improvised equipment, such as converted road oilers, will not be acceptable. The distributor shall be so designed as to permit the application of heated asphaltic material in a uniform spray without atomization at the rate, temperature, and pressure required. The distributor shall be equipped with a tachometer registering revolutions per minute and so located as to be visible to the driver in order that the driver may maintain the constant speed required for the specified rate of application. The distributor shall be mounted on a motor truck or trailer, equipped with pneumatic tires. The pump shall be equipped with a meter registering the number of gallons (liters) per minute passing through the nozzle and this meter must be visible to the operator. The distributor shall be equipped with an accurate thermometer which indicates the temperature of the asphaltic materials at all times. The distributor shall be equipped with a full circulating spray bar and shall be provided with hand nozzles to permit application to areas not accessible to the spray bar. The distributor shall be equipped with a drip tray or other suitable means of preventing the dripping of material after the flow has been shut off.

E. ASPHALT SPREADER AND FINISHER

The mechanical asphalt spreader and finisher shall be self-propelled and shall be designed and equipped to spread upon the prepared surface without segregation of the mixture, a tamped and finished wearing surface of asphaltic concrete free from hollows and humps.

The machine shall be equipped with a hopper to receive the asphaltic concrete as it is dumped from the trucks and shall be designed so as to prevent the mixture from being deposited directly on the base or previously laid courses. The hopper shall have a suitable device to distribute the mix evenly across the full width of the screed. The machine shall be equipped with means of adjusting the thickness of the mat, and the transverse and longitudinal grade. It shall be equipped with a tamping or vibrating screed which shall be operated during the lay down process to compact the applied material to a uniform density. No part of the machine shall travel on the freshly laid material. There shall be auxiliary attachments for the machine so that it may be adjusted to lay widths as approved by the City's Project Manager.

F. ROLLERS

The number and type of rollers furnished shall be adequate to produce the specified density and a satisfactory surface. Rubber tire rollers will not be allowed for compaction of SLX Asphaltic Concrete.

Wheels of all rollers shall be smooth and free from openings or projections which would mar the surface of the Work. They shall be equipped with suitable devices necessary to prevent adhesion of bituminous material to the wheels. The rollers shall be equipped with water tanks for wheel sprinkling devices that extend the full width of each roller, and drip pans designed so as to prevent oil, grease, gas or diesel oil from spilling or dripping onto the asphaltic concrete surface.

6.03 EQUIPMENT (Continued)

G. SURFACE MILLING MACHINE

The milling shall be done with a commercially manufactured machine able to perform this work to the City's Project Manager's satisfaction. The milling machine shall be self-propelled and shall have sufficient power, traction, and stability to maintain an accurate depth of cut. Pavement removal by scarifying, motor grading or heating will not be allowed as milling.

The milling machine shall be equipped with automatic controls for establishing profile grades at each edge of the machine. The reference shall be the existing pavement or taut reference lines erected and maintained by the Contractor true to line and grade. A single reference may be used if the machine can maintain the designated transverse slope.

When referenced from existing pavement, the cold milling machine shall be controlled by a self-contained grade reference system provided by the machine's manufacturer for that purpose. The sensing point shall react to compensate for 25% of the actual change in elevation due to a hump or dip that is 3' (900 mm) or less in length. The self-contained grade reference system shall be used at or near the centerline of the street. On the adjacent pass with the milling machine, a joint matching shoe may be used.

Broken, missing, or worn teeth shall be replaced if the machine is unable to maintain the surface texture requirements.

The machine shall be equipped with a loading elevator to remove the milled material from the street surface.

The machine shall be equipped with means to effectively control dust generated by the cutting operation.

H. TRUCKS

Numbered trucks having tight, clean, smooth beds shall be used for transporting the freshly prepared asphaltic concrete to the site of the Work. The beds shall be sprayed, when necessary, to prevent the asphaltic concrete mixture from adhering to the bed, with a minimum quantity of approved lubricant. The equipment used and the frequency of spraying shall be determined by the City's Project Manager.

All trucks shall be equipped with a suitable waterproof canvas cover to protect the material as required by the City's Project Manager. Any truck that causes excessive segregation of materials by the action of its spring suspension or other contributing factors, or that causes undue delays, shall not be used for transporting the asphaltic concrete mixtures. All truck beds shall be so constructed that they may be insulated, when necessary. All truck boxes shall be equipped with box vibrators.

6.04 CONSTRUCTION METHODS

A. SUBGRADE

No measurement or direct payment shall be made for preparation of subgrade. The cost of preparation of subgrade shall be considered subsidiary to the other items of Work for which direct payment is made. Subgrade shall be prepared as described in Chapter 2 of these Standard Specifications.

B. CLEANING

Prior to the application of asphaltic materials on existing base, the surface on which the asphalt is to be placed shall be thoroughly cleaned by means of mechanical sweepers, street flushers, shovels, scrapers, and hand brooms as is necessary to remove all mud, matted earth, dust and other foreign materials. Power sweeping shall be conducted in such a manner as to keep dust and debris under control and cause a minimum of disturbance to surrounding areas. Material cleaned from the surface shall be removed and disposed of by the Contractor.

The cost of cleaning the existing surfaces to which asphalt is to be applied shall be considered subsidiary to other items for which payment is made.

C. SURFACE MILLING

Surface milling, where required, shall consist of removing and salvaging existing surfacing material to a depth and width as shown in the plans or as directed by the City's Project Manager. Surface milling shall not take place until all curb and gutter and all curb ramps adjacent to the area to be milled are complete unless otherwise approved by the City's Project Manager. Unless otherwise stated in the contract documents, the Contractor shall take possession of and promptly remove from the project all pavement millings which result from the performance of this work.

The interface between the surface milled area and the concrete gutter pan shall be cleaned of all old asphalt and maintained to provide a smooth, straight, and vertical surface.

The Contractor shall be responsible for location and protection of all manholes, valve boxes, and all other appurtenances, some of which may be below the surface of the street, and to protect equipment from the danger of striking same. Claims for any and all damages arising from hitting these appurtenances shall be the Contractor's responsibility. The Contractor shall have access to applicable records; however, the Contractor shall not rely upon these records to reveal all such hidden appurtenances.

The Contractor shall be held responsible for all appurtenances in the pavement surface which have been damaged or disturbed by the Contractor. The cost of repairing or replacing these damaged appurtenances shall be made at the Contractor's expense.

1. BASIS OF PAYMENT

SURFACE MILLING, completed in conformance with the plans and Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square yard. Such payment shall be full compensation for all surface preparation, milling, removal of materials, labor, tools, equipment, clean up and incidentals necessary to complete the Work.

6.04 CONSTRUCTION METHODS (Continued)

D. CORRECTION OF PAVEMENT FAILURES

After the surface milling and cleaning have been accomplished, the City's Project Manager shall examine the pavement structure to which the asphaltic concrete is to be applied. Any pavement failures shall be repaired as designated by the City's Project Manager. The cost of repairing pavement failures shall be measured and paid for at the appropriate unit prices or shall be accomplished as an Extra Work Item.

E. TACKING

This Work shall consist of the application of asphaltic materials to previously prepared bases or existing surfaces.

After the surface is completely cleaned and dry it shall have a tack coat of rapid curing cut back asphalt or emulsified asphalt applied sufficiently in advance of the laying operation to break or cure prior to the application of the surface coat.

Traffic shall not be permitted on the tack coat without the permission of the City's Project Manager, and the asphalt surface course shall be applied as soon as the tack breaks and the water has evaporated. The rate of application generally should be from 0.05 to 0.2 gallons per square yard, with the rate of application to be approved by the City's Project Manager. Tack or asphaltic cement shall be applied by hand to all vertical edges.

The cost of supplying and applying tack coat will not be measured for payment. It shall be considered subsidiary for other items to which direct payment is made.

F. NON-WOVEN PAVEMENT OVERLAY FABRIC PLACEMENT

Non-woven pavement overlay fabric and asphaltic cement sealant shall be placed at locations called for on the plans. This Work shall consist of the application of an asphalt sealant and the placement of a non-woven pavement overlay fabric over the entire prepared surface of the pavement to be surfaced or resurfaced with asphalt. Sealants are applied both to seal the existing surface and to provide a cement to adhere to the fabric. Emulsified asphalts are not acceptable for sealant.

Sealant and fabric shall be placed only when the ambient air temperature is 50° F or above. The pavement surface on which the sealant fabric is to be placed shall be dry and free of dirt, debris and other foreign matter. Joint and crack openings of 1/8" and larger shall be filled with a suitable material as directed by the City's Project Manager. The asphalt sealant shall be applied with distributor equipment at a rate of 0.25 to 0.30 gallons per square yard. The width of the asphalt sealant application shall be the fabric width plus 2" to 6" or the entire width of the pavement to be surfaced. Temperature of the sealant shall be not less than 280° F at the time of application to ensure a uniform spray pattern.

No drilling or skipping shall be permitted. Asphalt drools or spills shall be cleaned from the pavement surface to avoid flushing and possible fabric movement at these asphalt rich areas. Fabric lay-down equipment shall be used for placement of the fabric. Overlap of fabric joints shall be 1 to 3 inches.

6.04 CONSTRUCTION METHODS (Continued)

F. NON-WOVEN PAVEMENT OVERLAY FABRIC PLACEMENT (Continued)

Immediately after the placement, the fabric shall be embedded into the asphalt cement sealant with a pneumatic roller, unless otherwise directed by the City's Project Manager. The construction of the asphaltic concrete overlay shall follow closely the placement of the fabric. In the event the sealant bleeds through the fabric before the overlay is placed, the Contractor shall be required to spread a thin layer of sand or asphaltic concrete over the affected areas in order to prevent the fabric from being picked up by the construction equipment. The application of tack coat will not be required on the fabric prior to the placement of the asphaltic concrete unless a delay in the placement of the overlay results in the fabric becoming dry or dirty.

1. BASIS OF PAYMENT

Placement of the non-woven pavement overlay fabric shall be measured and paid for at the contract unit price bid per square yard for the item NON-WOVEN PAVEMENT OVERLAY FABRIC. Such payment shall be full compensation for cleaning and preparing the pavement surface, filling joint and crack openings; for furnishing, heating, and applying the asphalt sealant; for placement and rolling of the fabric; for furnishing and applying material for blotting the surface of the fabric as required; and for all equipment, labor, tools, and incidentals required to complete the Work.

G. HAULING

Every truck used to haul asphaltic concrete shall be equipped with a suitable water proof cover. The truck beds shall be clean and shall be constructed so that all materials remain in the bed while the truck is in transit.

H. JOINTING

Longitudinal and transverse joints shall be made in such a manner that well bonded and sealed joints are achieved. Joints between old and new pavement shall be made in such a manner as to insure a thorough and continuous bond between the old and new surface.

Cold joints shall be painted with a light application of asphalt cement before the adjacent material is placed. When placing surface course, a hot joint between lane placements shall be maintained as directed by the City's Project Manager.

Joints in the surface course shall be formed by any approved method that will produce a dense vertical joint; otherwise the previously laid surface course shall be cut back to its full depth so as to expose a fresh surface, after which the hot mixture shall be placed in contact with it and raked to proper depth and grade.

I. SPREADING

Asphaltic concrete used in the construction of sections having a uniform width as shown in the typical cross section of the plans, shall be spread and finished with an approved mechanical spreading and finishing machine. The operation of placing mixtures shall be continuous, as nearly as possible.

The asphaltic concrete mixture shall be dumped in the center of the hopper of the spreading machine. Care shall be exercised to avoid overloading and slopping over of the mixture on the base, pavement, or previously laid asphaltic concrete. The operating speed and depth of strike off of the spreading and finishing machine shall be regulated so as to produce a well-knit, uniform layer of the required compacted thickness.

6.04 CONSTRUCTION METHODS (Continued)

I. SPREADING (Continued)

The asphaltic concrete mixture shall be laid only upon a surface which is dry and free from frost.

When the asphaltic concrete mixture is placed in irregular or narrow sections, intersections, or other areas where it is impractical to spread and finish the mixture by methods previously specified, the Contractor may use other equipment or acceptable hand methods for spreading the mixtures, as approved by the City's Project Manager.

The cost of hauling, jointing and spreading the asphaltic concrete mixture shall be considered subsidiary to other items for which payment is made.

J. COMPACTION

Immediately after spreading, the mixture shall be compacted thoroughly by rolling. The number, weight, types of rollers, sequence of rolling operations and compaction procedures shall be such that the required density and a satisfactory surface are attained consistently while the mixture is in a workable condition.

The initial rolling shall begin as soon as the material will bear the weight of the roller without displacing the material. The final compaction and finishing shall be performed by rollers while the material is still hot and responds to the action of the roller. Rolling shall not be carried on in such a manner or at such a time as will cause shoving or cracking. No additional rolling or compaction will be allowed after final compaction.

The asphaltic concrete shall be compacted to required density such that the completed surface is slightly above the surface of the concrete at the gutter pan joint. This compaction shall be attained without the roller coming into contact with the concrete gutter pan and shall be smooth, true and conform to the grade, cross section and contour required without any irregularities that exceed 1/8" when tested with a 10' straightedge. All variations in excess of 1/8", measured from the surface of the pavement in place with a 10' straightedge or other device used for measuring deviations from a plane, shall be plainly marked. The Contractor shall eliminate such variations. When the surface finish of the pavement has been disturbed by grinding, the surface shall be repaired with the use of an approved sealant. The use of mechanical grinders will be permitted if their use does not, in the opinion of the City's Project Manager, damage the pavement. Sections of pavement containing depressions which cannot be corrected by grinding shall be repaired or replaced by the Contractor to the satisfaction of the Engineer.

All areas not accessible to the equipment specified shall be compacted and finished by other equipment and methods that will provide a satisfactory surface and the specified density. Any areas determined by the City's Project Manager to be defective, shall be immediately reworked to the satisfaction of the City's Project Manager.

No measurement or direct payment shall be made for the operation of rolling asphaltic concrete pavement. The cost thereof shall be considered subsidiary to other items for which direct payment is made.

6.04 CONSTRUCTION METHODS (Continued)

K. ASPHALTIC CONCRETE CURB

Asphaltic concrete curb shall be constructed of a mix as shown on the plans or approved by the City's Project Manager. The curb shall conform to the shape and dimensions that are shown on the plans.

Whenever possible the asphaltic concrete curb shall be shaped and compacted with a curb machine capable of constructing the curb true to line, grade, and cross section and to a density and with a surface texture which is satisfactory to the City's Project Manager.

Special precautions shall be taken to provide a proper bond between the surface course and the curb. The surface shall be thoroughly cleaned and tacked with hot asphalt cement. If performed during cool weather, the surface course shall be heated so that it is sufficiently plastic to form a bond with the hot asphaltic concrete curb.

1. BASIS OF PAYMENT

ASPHALTIC CONCRETE CURB shall be paid for at the contract unit price bid per linear foot.

L. COLD WEATHER PLACEMENT

Asphaltic concrete shall not be placed on frozen or frost covered sub-grade or base. The Cold Weather Placement table shown below shall be used by the City's Project Manager to restrict the routine placement of asphaltic concrete as a result of cold temperatures. Wind velocity, cloud cover, and other project specific conditions will be considered by the City's Project Manager if deviating from Table 6.04A.

TABLE 6.04A – COLD WEATHER PLACEMENT

Lift Thickness	Minimum Surface Temperature
Less than 2"	45° F
2 to 3"	37° F
Greater than 3"	35° F

Tarping and insulation of haul trucks will be required if it is determined by the City's Project Manager that minimum and uniform temperature control of the mixture is not being maintained. Each surface of the haul truck's bed shall be insulated and have an "R" value of approximately 1.0. All insulating material shall be firmly attached to the truck box, either inside or outside, and shall have no bulges, rips, gaps or uneven seams.

M. ASPHALTIC CONCRETE TEMPERATURE REQUIREMENTS

The minimum temperature of the asphaltic concrete for placement for SLX shall be 285° F and 250° F for all other mixes unless otherwise approved by the City's Project Manager.

No traffic or additional construction shall be allowed on the compacted asphaltic concrete until it has cooled beyond 150° F unless otherwise approved by the City's Project Manager.

6.05 DENSITY CORE SAMPLES

A. GENERAL

During the construction of asphaltic concrete pavement, the Contractor shall obtain core samples from each pavement lift for the determination of density. A minimum of one sample shall be required for each lot of asphaltic concrete. These samples shall be taken not later than two working days after the date of placement of the asphaltic concrete at locations designated by the Engineer. Cores shall be a minimum of 4" in diameter and shall be taken under direct supervision of the City's Project Manager and given to him/her immediately after removal from the pavement. The surfaces from which the samples have been taken shall be cleaned, dried, filled and compacted by the Contractor with hot asphaltic concrete mixture immediately after core removal. Density samples shall be tested in conformance with the Nebraska Standard Method of Tests for specific gravity of compressed bituminous mixtures, AASHTO T 166.

B. COMPACTION REQUIREMENTS

Asphaltic concrete shall be compacted to a density of not less than 92.5% of the void-less density for that mixture. The void-less density for each lot sample shall be tested in conformance with the Nebraska Standard method of test for Maximum Specific Gravity of Bituminous Paving Mixtures, AASHTO T 209. If any density test result indicates a compaction value of less than 92.5% of the void-less density, two additional cores will be obtained from that lot by the Contractor at points designated by the City's Project Manager. These samples shall be taken and the surface restored as described above not later than seven days after the date of placement of the asphaltic concrete. The average density of the three samples shall be considered the density of the lot.

Regardless of layer thickness, Asphaltic Concrete Type SLX will be monitored for density. An initial rolling pattern test strip shall be completed to determine the rolling pattern that will target a minimum of 92.5% density. The Contractor shall monitor the density through a combination of rolling pattern and field testing as deemed necessary by the Engineer.

C. OVERLAYS

Overlays shall be sampled and tested for density when the average thickness of the overlay is greater than 1". The average overlay thickness shall be determined from the core samples located by the City's Project Manager as described above. The thickness of the samples shall be the average of four measurements made at four equally spaced locations on the perimeter of the sample. When the average thickness is 1" or less the testing of density for this layer shall be waived with the exception of the SLX requirements.

6.06 BASIS OF PAYMENT

Asphaltic concrete shall be paid for on a lot basis, as described above, at the contract unit price bid per ton for ASPHALTIC CONCRETE, TYPE and subject to the payment tables for production density and air voids and AC content as described below. The amount of asphaltic concrete to be paid for shall be the net weight of the material actually incorporated into the work. Such payment shall be full compensation for all mixing, hauling, tack coats, spreading, compacting to required density, materials, equipment, tools, labor, and incidentals necessary to construct the asphaltic concrete surface course to the required thickness or as directed by the City's Project Manager.

TABLE 6.06A – DENSITY ACCEPTANCE SCHEDULE

Average Density	Min. # Samples	% of Payment
92.5 and above	1	100
92.0 to 92.4	3	95
91.5 to 91.9	3	90
91.0 to 91.4	3	85
90.5 to 90.9	3	80
90.0 to 90.4	3	70
89.9 or less	3	40 or reject

TABLE 6.06B – AIR VOID ACCEPTANCE SCHEDULE

Air Voids (SPR & SLX)	Air Voids (SPH)	% of Payment
Less than 0.5	Less than 1.5	50 or reject
0.5 to 0.9	1.5 to 1.9	50 or reject
1.0 to 1.4	2.0 to 2.4	95
1.5 to 1.9	2.5 to 2.9	98
2.0 to 4.0	3.0 to 5.0	100
4.1 to 4.5	5.1 to 5.5	98
4.6 to 5.0	5.6 to 6.0	95
5.1 to 5.5	6.1 to 6.5	90
5.6 to 6.0	6.6 to 7.0	50 or reject
More than 6.0	More than 7.0	50 or reject

TABLE 6.06C – AC CONTENT ACCEPTANCE SCHEDULE

% Below Minimum AC	% of Payment
0.00 to 0.14	100
0.15 to 0.24	80
0.25 to 0.34	70
0.35 to 0.40	60
Greater than 0.40	50 or reject

6.07 JOINT AND CRACK REPAIR

This section details the requirements and types of repairs to be performed in the joints/cracks that have developed in Asphaltic Concrete Pavement. The use of an approved joint sealer as specified by Section 4.01F or the contract documents shall be required.

Following is a listing of the types of joint/crack and the method of repair.

Type 1	Less than 1/4"	Clean and Seal
Type 2	1/4" - <3/4"	3/4" X 3/4" Rout and Seal
Type 3	3/4" – 1 1/2"	Clean and Seal
Type 4	Greater than 1 1/2"	Crack repair as required in project documents

Sealing operations shall take place when pavement temperatures are between 40° F and 70° F to ensure that the openings are at their midpoint to maximum point of expansion.

A. JOINT AND CRACK SEALING

Unless otherwise approved by the City's Project Manager. Just prior to sealing, each joint/crack shall be thoroughly cleaned of all foreign material, using approved equipment, and the joint/crack faces shall be clean and surface dry when the sealer is applied.

The joint/crack shall be cleaned by high pressure compressed air or other approved methods to remove all residues. The use of a heat lance may be required to properly dry and warm the vertical edges with care being taken not to burn, scorch or ignite the adjoining pavement. The joint/crack shall be filled from the bottom to the top without formation of voids. At the time of application of the joint/crack sealant, the joint/crack and pavement shall be dry and acceptable to the City's Project Manager. No sealant shall be placed during unsuitable weather or when the atmospheric temperature is below 50° F or when weather conditions indicate that the temperature may fall below 32° F within 24 hours.

The joint/crack sealing filler shall be melted uniformly and with constant stirring in an asphalt kettle of the double boiler design with oil being used as the heating medium. The material shall be furnished or prepared in pieces of such size and shape that the material can be melted readily to the proper pouring consistency. The Contractor shall obtain from the supplier or from the manufacturer and furnish to the City's Project Manager the manufacturer's recommendations for mixing, application and temperature restrictions. These recommendations shall be followed strictly. In no case shall the temperature exceed the maximum recommended by the manufacturer. When proper pouring consistency is attained, the joints/cracks shall be filled as shown in the plans, through the use of pressure type applicator, of a design approved by the City's Project Manager and equipped with a nozzle which will fit into the joints/cracks. The use of an applicator disk or squeegee shall be required to maintain the final level of sealer flush with the surface of the pavement and not to exceed a 3 1/2" banding of the material. If the pavement is to be resurfaced within 12 months the sealer shall be left 1/4" – 3/8" below the surface.

All adjoining surfaces shall be carefully protected during the joint/crack sealing operations, and any stains, marks or damage thereto, as a result of the Contractor's operations, shall be corrected in a manner satisfactory to the City's Project Manager.

6.07 JOINT AND CRACK REPAIR (Continued)

B. BASIS OF PAYMENT

JOINT AND CRACK SEALING OF ASPHALTIC CONCRETE

JOINT/CRACK SEALING, shall be constructed in conformance with the Plans and the Lincoln Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per linear foot for JOINT AND CRACK SEALING OF ASPHALTIC CONCRETE.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 7

RETAINING WALLS AND STEPS (Minor Structures at or under 47")

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CHAPTER 7

RETAINING WALLS AND STEPS (Minor Structures at or under 47")

7.00 GENERAL

The Work covered in this Chapter includes the construction of both reinforced concrete retaining walls/steps and modular block concrete retaining walls/steps at or under 47" in height with or without a surcharge as per Lincoln Standard Plans except when the surcharge is caused by a building.

The Work shall include furnish and install retaining walls and all related materials required for the construction to lines and grades as shown on the plans and as specified herein. Prepare foundation soils, leveling pad, and backfill to lines and grades as required.

Examples of all products used in the work of this section, including available colors and texture, shall be provided to the City's Project Manager, if required, for selection ahead of the Work being completed.

7.01 MATERIALS

A. CONCRETE

Unless otherwise specified, all concrete for reinforced, poured-in-place walls and steps shall be L3500 as described in Chapter 3 of these Standard Specifications.

B. REINFORCEMENT STEEL

Reinforcement steel shall be free from excess rust, scale or other substances and shall be protected at all times from damage. All reinforcements shall be placed in the exact position shown in the plans, and shall be held securely in position by suitable means so they will not displace during the process of depositing or consolidating the concrete.

1. Reinforcement Bars

All reinforcement bars shall meet the requirements of "Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement", ASTM Designation A 615 (A 615M), Grade 40 (300) or Grade 60 (420).

2. Reinforcement Bar Supports

Reinforcement bar supports shall be of a satisfactory design and of sufficient strength to hold the metal reinforcement in place while the concrete is being placed.

7.01 MATERIALS (Continued)

C. PREFORMED JOINT FILLER MATERIAL

1. Bituminous joint fillers shall conform to the requirements for “Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)”, ASTM Designation D 1751.
2. Sponge rubber and cork expansion joint filler shall conform to the requirements of “Standard Specifications for Preformed Rubber Sponge and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction”, ASTM Designation D 1752.
3. Synthetic rubber or neoprene water stops of approved type shall be installed as indicated on the plans.

D. WATERPROOFING

Waterproofing shall conform to the “Standard Specification for Asphalt Used in Dampproofing and Waterproofing”, ASTM Designation D 449 Type I, or other commercially produced products intended for this use and approved by the City’s Project Manager. The provisions in the above referenced Standard Specifications relating to felt, asbestos felt, and cotton fabrics shall not apply.

Primer for use with asphalt in waterproofing shall conform to the “Standard Specifications for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing” ASTM Designation D 41.

E. CURING COMPOUNDS

All curing compounds shall conform to the requirements of Chapter 3 of these Standard Specifications.

F. HANDRAIL

Handrail systems shall conform to “Standard Specification for Permanent Metal Railing Systems and Rails for Buildings”, ASTM Designation E 985. Handrail shall consist of a rail element supported by metal brackets (wall type) or rail elements supported by posts (post type). Posts and rails shall be commercial quality structural steel tubing conforming to “Standard Specification for Carbon Structural Steel”, ASTM Designation A 36. Brackets, bolts, nuts, washers and other fittings shall be commercial quality structural steel, except where shown otherwise on the plans.

Handrail shall be galvanized or painted to resist corrosion as approved by the City’s Project Manager.

7.01 MATERIALS (Continued)

G. CONCRETE UNITS

Modular Block Retaining Walls shall be retaining wall units designed to create a block wall. Concrete retaining wall units shall have a minimum net 28-day compressive strength of 3,000 psi. The concrete shall have a maximum moisture absorption of 6 to 8 lbs/ft. Exterior dimensions may vary in conformance with ASTM C90 "Standard Specification for Loadbearing Concrete Masonry Units." Unless otherwise specified, full-size units shall have a minimum of 1 square foot face area each. Partial units shall have a minimum 1/2 square foot face area each. Units shall have angled sides capable of concave and convex alignment curves with a minimum radius of 10'. NOTE: Where applicable, for straight walls use non-angled straight side cap units. Reference: ASTM C 140 – Standard Specification for Sampling and Testing Concrete Masonry Unit and Related Units and ASTM C 1372 – Standard Specification for Dry-Cast Segmental Retaining Wall Units

H. GEOGRID

Geogrid to be used as soil reinforcement shall be a regular grid structure of high-density polyethylene (HDPE), High-Tenacity PET Geogrids, or geotextiles manufactured for soil reinforcement applications. Geogrid shall be a horizontal layer of high strength high modulus grid capable of creating a composite soil/geogrid mass that acts as a monolithic gravity structure. Reference: ASTM D 638 – Standard Test Method for Tensile Properties of Plastic; ASTM D 4439 – Standard Terminology for Geosynthetics; ASTM D 4595 – Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method; ASTM D 5262 – Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics; ASTM D 5321 – Standard Test Method For Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic by Direct Shear Method; ASTM D 6706 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.

I. BASE LEVELING PAD MATERIALS

Material shall consist of compacted crushed stone, 3/4" or smaller, well-compacted gravel, or coarse sand, and underdrains as required. Minimum thickness is 6".

Concrete LB-2750 conforming to the requirements of Chapter 3 may be used also with underdrains as required. Minimum thickness is 3".

7.02 EXCAVATION AND BACKFILL

All earthwork shall conform to the requirements of Chapter 2 of these Standard Specifications.

When called for on the Proposal, the established quantity of excavation (as provided in Chapter 2) shall include all earthwork necessary for the placement of the retaining walls and steps at the locations shown on the plans and cross sections.

When retaining walls or steps are called for on the Contract and no earthwork is bid on the proposal, all excavations and compacted backfill required for the completion of the retaining walls and steps shall be considered subsidiary to other items of Work for which direct payment is made.

Where additional fill is required, the Contractor shall submit sample to the City's Project Manager to determine if acceptable. Backfill zone shall extend to encapsulate all Geogrids.

7.03 REINFORCED CONCRETE INSTALLATION

A. 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 removed completely from forms before any concrete is deposited therein. The surfaces 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 reused. 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.

1. BRICK FACED FORMS

Forms used for brick facing shall be cast aluminum or approved equal, unless otherwise specified by the City's Project Manager. The forms shall have a simulated brick face and be of a size, type, shape, quality and strength to insure construction as designed.

2. SMOOTH FINISH FORMS

Forms requiring a smooth finish shall be fabricated of wood, metal or other approved materials to insure construction as designed. Wood forms shall be constructed and maintained to prevent warping and opening of joints due to shrinkage of lumber.

No direct payment will be made for forms. Forming shall be considered subsidiary to other items of Work for which direct payment is made.

B. REINFORCING STEEL

All reinforcing steel shall be furnished in full length, except where splices are indicated in the plan or permitted by the City's Project Manager. Splices in adjacent bars shall be staggered. Unless otherwise shown in the plans, bars shall be spliced by lapping the ends. Laps shall be a minimum length of 36 bar diameters for Grade 40 (300) and 24 bar diameters for Grade 60 (420) steel. Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment and clearances.

When bending is required, it shall be done accurately without the use of heat, and bars having cracks or splits at the bends shall be rejected. Stirrups and tie bars shall be bent around a pin of not less than 6 times the least dimension of the bar. Where there is a delay in depositing the concrete, the reinforcement shall be reinspected and, where necessary, cleaned.

C. CONCRETE PLACEMENT

Before placing any concrete, all dirt and other debris shall be removed from the forms. Concrete shall be handled by methods which will prevent the separation or loss of ingredients and the formation of laitance. Concrete free fall distance shall not exceed 5'. This includes free fall in a discharge pipe when using a conveyor system for placement. Pumped concrete is not considered in free fall until the concrete exits the pumper hose. The concrete shall be placed in its final position, as nearly as possible, to avoid re-handling. The concrete shall be placed and thoroughly consolidated in level layers not exceeding 12" in thickness. Suitable means shall be provided to permit concrete to be placed in a manner which will avoid accumulations of dry or hardened concrete on the forms or reinforcement.

1. VIBRATING

All concrete shall be thoroughly consolidated by means of approved mechanical vibrators. The vibrator shall consolidate the full depth and width of the concrete to a uniform mass without segregation. Care must be exercised to insure the coating of all surfaces of the reinforcement with concrete and the thorough consolidation of concrete around the reinforcement. Equal care shall be taken to ensure that all concrete is consolidated against the face of the forms.

No direct payment will be made for vibrating. Vibrating shall be considered subsidiary to other items of Work for which direct payment is made.

2. SURFACE FINISH

After removal of the forms all smooth finished exposed surfaces of the concrete shall be rubbed starting as soon as conditions permit. Immediately before starting this Work the concrete shall be thoroughly saturated with water.

Sufficient time shall have elapsed before the wetting is done to allow the mortar used in the pointing of tie wire or tie rod holes and defects to be thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse Carborundum stone using a small quantity of mortar on its face. The grout shall be composed of cement and fine sand mixed in the proportion used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface finish has been obtained. The paste produced by this rubbing shall be left in place at this time.

The final finish shall be obtained by rubbing with a fine Carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color. After the final rubbing is completed and the surface dried, it shall be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks. Epoxy or latex sealant may be used in lieu of the above, with the approval of the City's Project Manager.

After removal of brick-faced forms, all irregularities in the finish shall be corrected to the satisfaction of the City's Project Manager. All tie wire and tie rod holes shall be pointed up with grout. All ridges at form joints shall be chipped off and pointed up. These and all other irregularities in the finish shall be made to match the configuration of the simulated brick surface, as nearly as possible.

7.03 REINFORCED CONCRETE INSTALLATION (Continued)

C. CONCRETE PLACEMENT (Continued)

2. SURFACE FINISH (Continued)

No direct payment will be made for surface finish. The cost of the Work required to provide the surface finish shall be considered subsidiary to other items of Work for which direct payment is made.

D. JOINTS

Joints shall be square and normal to the forms unless otherwise provided. Bulkheads shall be provided for all except horizontal joints. When shown in the plans or specified in the Special Provisions, joints shall be sealed.

1. CONSTRUCTION JOINTS

Construction joints shall consist of the joints in which no provision is made for movement of abutting surfaces. All construction joints shall be keyed and shall be made only where located in the plans, unless otherwise provided in these Standard Specifications and approved by the City's Project Manager. When not detailed in the plans, or in case of emergency, construction joints shall be placed as directed by the City's Project Manager.

2. SURFACE FINISH

The surface of the hardened concrete shall be roughened as required by the City's Project Manager, in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance, and saturated with water. A thin layer of grout shall be applied to the cleaned and saturated surface immediately prior to placing the fresh concrete.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation.

3. EXPANSION JOINTS

Expansion and fixed joints shall be constructed according to the details shown in the plans. Expansion joints shall include those in which provision, in some manner or other, is made for movement by sliding or by deflection.

When preformed expansion joints are specified, the material shall be placed in correct position as the concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed.

7.03 REINFORCED CONCRETE INSTALLATION (Continued)

D. JOINTS (Continued)

4 WATER STOPS

Water stops shall be furnished and placed as provided in the plans. They shall be synthetic rubber or other approved material. They shall form continuous watertight joints.

No direct payment will be made for joints or water stops. The construction of joints and water stops shall be considered subsidiary to other items of Work for which direct payment is made.

E. WATERPROOFING

The back face of all retaining walls over 2' high shall be damp-proofed above the top of the footing. The surfaces to be damp-proofed shall be free from dust, sand, mud, mortar and other loose particles, all grease spots or marks of soil shall be removed by washing with an approved solvent.

After the surfaces have been thoroughly cleaned and dried, and if asphalt is the intended waterproofing, they shall be uniformly coated with one coat of primer and two coats of hot waterproofing asphalt.

The primer may be applied cold, but the asphalt shall be applied at a temperature of at least 250° Fahrenheit. Each coating shall be allowed to dry before the next coating is applied.

The primer shall be applied in quantities sufficient to thoroughly cover the surfaces to be treated. The waterproofing asphalt shall be applied at a rate of not less than 5 gallons per 100 square feet of surface.

If using other approved commercially produced products, the waterproofing shall be applied as per manufacturers' Specifications and directions.

Care shall be exercised to confine all damp-proofing materials to the area being treated and to prevent disfigurement of any exposed part of the structure by dripping or spreading of asphalt.

No direct payment for waterproofing will be made. Waterproofing shall be considered subsidiary to other items of Work for which direct payment is made.

F. WEEPHOLE / DRAINAGE COLLECTION PIPE

Weep-holes shall be constructed in all retaining walls as shown on the plans or as directed by the City's Project Manager.

No direct payment for the placement of weep-holes will be made. Placement of weep-holes shall be considered subsidiary to other items of Work for which direct payment is made.

7.03 REINFORCED CONCRETE INSTALLATION (Continued)

G. CURING AND PROTECTION

1. CURING

As soon after the completion of the specified finishing operation as the condition of the concrete will permit without danger of consequent damage thereto, all exposed surface shall be cured by the water method, the form-in-place method, or by the membrane curing compound method.

a. Water Method

The concrete shall be kept continuously wet by application of water for a minimum period of 72 hours after the concrete has been placed. Burlap, earth, or sand may be used as a curing medium to retain the moisture. The entire surface of the concrete shall be kept damp such that the concrete is covered with the curing medium.

b. Form-In-Place Method

Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 72 hours after the concrete has been placed.

c. Membrane Curing Compound Method

All surfaces which are exposed to the air shall be sealed with a uniform application of a membrane curing compound applied at a rate of 1 gallon per 200 square feet of surface area. The curing compound shall be applied using an approved mechanical power sprayer of a size and capacity to complete the Work. The curing compound shall meet the requirements of Chapter 3 of these Standard Specifications.

2. PROTECTION

The Contractor shall provide protective measures at their own expense to prevent damage to the Work. The Contractor shall be responsible for any damage caused by the construction operation. Any concrete showing injury from vandalism shall be repaired or removed and replaced at the Contractor's expense.

No direct payment will be made for curing and protection. The cost of curing and protection shall be considered subsidiary to other items of Work for which direct payment is made.

H. HOT AND COLD WEATHER CONSTRUCTION

Concrete Work on retaining walls and steps shall not be performed during inclement weather except with specific permission of the City's Project Manager. During hot or cold weather, the Work may proceed in conformance with Chapter 3 of these Standard Specifications.

7.04 MODULAR BLOCK INSTALLATION

Installation shall be according to the latest edition of manufacturer's Specifications for methods of installation. Contractor shall arrange a meeting with the authorized technical representative, the Contractor, and the City's Project Manager to review the manufacturer's recommendation prior to construction. In-lieu of this meeting the authorized technical representative and Contractor shall sign off agreement to the following Standard Specifications:

A. PREPARATION

Contractor shall excavate to the lines and grades shown on the construction drawings. Over excavation shall not be paid for and replacement with compacted fill and/or wall system components will be required at contractor expense. Contractor shall be careful not to disturb embankment materials beyond lines shown.

B. FOUNDATION SOIL PREPARATION

Foundation soil shall be excavated as required for footing dimensions shown on the construction drawings or as directed by the City's Project Manager. Foundation soil shall be examined by the City's Project Manager to assure that the actual foundation soil strength meets or exceeds assumed design strength. Soils not meeting required strength shall be removed and replaced with acceptable material. Over-excavated areas shall be filled with approved compacted granular fill backfill material. Foundation shall be proof rolled prior to fill and geogrid placement.

C. BASE LEVELING PAD

Leveling pad materials shall be placed upon undisturbed in-situ soil. Material shall be compacted so as to provide a level hard surface on which to place the first course of units. Mechanical Compaction shall be to 96% of standard proctor. Leveling pad shall be prepared to insure complete contact of retaining wall unit with base. Leveling pad materials shall be to the depths and widths required. Well-graded sand can be used to smooth the top 1/4" to 1/2" of the leveling pad. In no case shall the compacted leveling pad shall be less than a minimum 6" thick if well-compacted gravel, crushed stone or coarse sand or 3" thick if LB-2750 Concrete.

D. UNIT INSTALLATION

First course of concrete wall units shall be placed on the base leveling pad. The units shall be checked for level and alignment. The first course is the most important to insure accurate and acceptable results. Insure that units are in full contact with base. Units are placed side by side for full length of wall alignment. Alignment may be done by means of a string line or offset from base line. Install connecting devices and fill all voids at units with unit fill material. Tamp fill. Sweep all excess material from top of units and install next course. Insure each course is completely unit filled, backfilled and compacted prior to proceeding to next course. Lay up each course insuring that connectors protrude into adjoining courses above a minimum of 1". Pull each unit forward, away from the embankment, against connectors in the previous course and backfill as the course is completed. Repeat procedure to the extent of wall height. The top two courses of wall units below the cap shall also have an adhesive or epoxy to provide a permanent bond of the upper blocks. As appropriate where the wall changes elevation, units can be stepped with grade or turned into the embankment with a convex return end. Provide appropriate buried units on compacted leveling pad in area of convex return end.

7.04 MODULAR BLOCK INSTALLATION (Continued)

E. CAP INSTALLATION

Place Modular Block Cap units over projecting connectors from units below. Pull forward to set back position. Back fill and compact to finished grade. As required, provide permanent mechanical connection to wall units with construction adhesive or epoxy. Apply adhesive or epoxy bottom surface of cap units and install on units below.

F. GEOGRID INSTALLATION

The geogrid soil reinforcement shall be laid horizontally on compacted backfill. Connect to the concrete wall units by hooding geogrid over connector units. 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 as shown on the construction drawings or as directed by the City's Project Manager. Correct orientation (roll direction) of the geogrid shall be verified by the contractor. To pretension geogrid, pull pinned geogrid taut to eliminate loose folds. Stake or secure back edge of geogrid prior to and during backfill and compaction. The Contractor shall follow manufacturer's guideline relative to overlap requirement of uniaxial and biaxial geogrids.

G. FILL PLACEMENT

Backfill material shall be placed in 8" lifts and compacted to 96% of Standard Proctor. Backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack or loss of pretension of the geogrid. Only hand-operated compaction equipment shall be allowed within 3' of the back surface of the Modular Block units. Backfill shall be placed from the wall rearward into the embankment to ensure that the geogrid remains taut. Tracked construction equipment shall not be operated directly on the geogrid. A minimum backfill thickness of 6" is required prior to operation of tracked vehicles over 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. Fill placed 1' behind the geogrid units shall be wrapped in filter fabric as shown on the plans. A 6" overlap of the filter fabric shall be provided at the top of each layer of stone backfill. The fill placement shall be coordinated with the installation of handrails, fences, or guiderails. There shall be 12" of topsoil on the surface.

H. WEEPHOLE / DRAINAGE COLLECTION PIPE

Weep-holes shall be constructed in all retaining walls as shown on the plans or as directed by the City's Project Manager. No direct payment for the placement of weep-holes will be made. Placement of weep-holes shall be considered subsidiary to other items of Work for which direct payment is made.

7.05 FENCE PLACEMENT

Fences shall be placed along the tops of retaining walls where shown on the plans. These fences shall be constructed in conformance with the provisions of Chapter 8 of these Standard Specifications.

7.06 HANDRAIL PLACEMENT

Handrails shall be placed at the locations and in conformance with the details shown on the plans, and as specified in these Standard Specifications and the Special Provisions, and as directed by the City's Project Manager. The type of railing to be constructed shall be specified in the special provisions or shown on the plans. All handrails, posts, and paint shall be of the size and materials as shown on the plans, Standard Specifications, or as directed by the City's Project Manager.

The railing shall be erected true to line and grade. Posts shall be set vertical. All welds shall conform to the latest requirements of the American Welding Society. All welds on exposed surfaces shall be ground flush with the adjacent surfaces.

Primer paint shall be applied to a dry thickness of 2.0 to 3.5 mils and 2 coats of enamel shall be applied to a dry thickness of 1.5 to 2.5 mils for each coat.

7.07 SUBSTANTIAL COMPLETION

Retaining walls and steps will be considered substantially complete when all elements of the wall are placed and finished, backfill completed, and handrail completed.

7.08 BASIS OF PAYMENT

A. CONCRETE FOR STEPS AND RETAINING WALLS, IN PLACE

Payment for CONCRETE FOR STEPS AND RETAINING WALLS, IN PLACE, shall be based on the contract unit price bid per cubic yard, based upon the quantity of concrete required for the Design Section, unless otherwise specified. No actual measurement of the volume of concrete will be made. Such payment shall be full compensation for furnishing, preparing, transporting, delivering and placing all materials, except those for which the contract provides that direct payment shall be made, for work and materials for forms, falsework, bracing, etc.; incidental excavation and compacted backfill; and for all labor, equipment, tools and incidentals necessary to complete the Work.

B. REINFORCING STEEL FOR RETAINING WALLS AND STEPS

Payment for REINFORCING STEEL FOR RETAINING WALLS AND STEPS, IN PLACE, constructed in conformance with the plans and Standard Specifications, and accepted by the City's Project Manager, shall be based on the contract unit price bid per pound, based upon the quantity of reinforcing steel required for the Design Section, unless otherwise specified. No actual weighing of steel will be made. Such payment shall be full compensation for furnishing, bending, fabricating and placing the reinforcements; for all clips, spacers, ties, wire or other material used for fastening reinforcement, in place; and for all tools, labor, equipment and incidentals necessary to complete the Work.

C. MODULAR BLOCK RETAINING WALL

MODULAR BLOCK RETAINING WALL constructed in conformance with the manufacturer's Specifications and installation instructions, and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square foot, based on the total area of the retaining wall installed. Such payment shall be full compensation for furnishing, preparing, transporting, delivering, placing and installing all materials including retaining wall units, geogrid reinforcement, fill, backfill, foundation preparation, and furnishing/installing leveling pad except those for which the contract provides that direct payment shall be made, incidental excavation and compacted backfill; and for all labor, equipment, tools and incidentals necessary to complete the Work. Modular Block Retaining Wall Systems shall be constructed according to the manufacturer's specifications.

D. HANDRAILS, COMPLETE

HANDRAILS, COMPLETE, constructed in conformance with the plans and Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per foot, based on the total length of the top rail. Said payment shall be full compensation for the top rail, post or mounting brackets, erection, paint and all other tools, materials, labor and incidentals necessary to complete the Work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 8

CHAIN LINK FENCE AND PIPE RAILING FENCE

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CHAPTER 8

CHAIN LINK FENCE AND PIPE RAILING FENCE

8.00 GENERAL

The Work covered in this chapter shall include the installation of chain link fence and pipe railing fence.

8.01 MATERIALS

A. CHAIN LINK FENCE

Materials for chain link fence shall be standard commercial products which meet the general requirements of these Standard Specifications.

Chain link fence fabric shall be No. 9 gauge wire woven in a 2" mesh. Fabric shall be the height indicated on the plans with both edges selvaged, twisted and barbed and shall be zinc-coated by the hot-dip process after fabrication.

End, corner, pull posts and intermediate posts shall be round tubular steel having a nominal outside diameter of 2 3/8" and weight of 3.65 pounds per foot.

Post braces and top rail shall be round tubular steel having a nominal outside diameter of 1 1/2" and weight of 2.72 pounds per foot.

Reinforcing wire shall be No. 7 gauge coiled spring wire.

Stretcher bars shall not be less than 3/16" x 3/4" x the length required for the height of the fabric supplied, but in no case less than 6" shorter than the height of the specified fabric.

Post tops shall be ornamental.

Zinc coating shall be applied to all steel and iron parts after fabrication.

Pipe sleeves shall be round, galvanized steel, have a nominal inside diameter of 2 1/2" and a minimum length of 12".

B. PIPE RAILING FENCE

Materials for pipe railing fence shall be standard commercial products which meet the general requirements of the Standard Specifications.

All pipe used for railing shall be round tubular steel (Schedule 40) galvanized pipe having a nominal outside diameter of 1 3/8".

All end, corner and intermediate posts shall be round tubular steel (Schedule 40) galvanized pipe having a nominal outside diameter of 1 3/8".

The tee, cross, elbow and flange connectors shall be malleable iron connectors as approved by the City's Project Manager. The connectors are not to be welded or threaded type, but shall be of the reusable type having case hardened set screws to provide connection.

8.01 MATERIALS (Continued)

B. PIPE RAILING FENCE (Continued)

Pipe sleeves shall be round, galvanized steel, have a nominal inside diameter of 1 1/2" and a minimum length of 12".

Zinc coating shall be applied to all steel and iron parts after fabrication.

C. RIGID CELLULAR PLASTIC BACKFILL

Rigid cellular plastic backfill shall be manufactured for the intended purposes and conform to the test requirements of "Standard Test Method for Compressive Properties of Rigid Cellular Plastic" ASTM Designations D 1621, and "Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics" D 1623.

D. POLYURETHANE SEALANT

Polyurethane sealant shall be one-part, self leveling, conforming to the requirements of "Standard Specifications for Elastomeric Joint Sealants" ASTM Designation C 920, Type S, Grade P, Class 25.

8.02 CHAIN LINK FENCE INSTALLATION

A. GENERAL

New chain link fence shall be installed at the locations shown and as dimensioned and detailed on the plans.

Post spacing for posts not to be on concrete walls shall not exceed 10' and shall be set in 3' of concrete base 12" in diameter. The exposed surface of concrete shall be crowned to shed water.

Post spacing for posts to be set on concrete wall shall not exceed 10' or shall be at intervals shown on the plans. Posts shall be set into pipe sleeves cast into the wall and shall extend a minimum of 12" into the sleeve.

Posts in wall shall be set using rigid cellular plastic foam backfill. Sufficient material shall be placed in the pipe sleeve to completely fill the annular space to within 3/16" below the top of the sleeve. Care shall be taken to ensure that the annular space is filled in such a manner as to prevent voids in the plastic foam. Excess material shall be cut off and removed so as to leave a 3/16" reservoir. The resulting reservoir shall be filled with one-part, self-leveling polyurethane sealant installed in conformance with the manufacturer's recommendations.

End, corner, and pull posts shall be braced to nearest point with tubular steel post brace with a 3/8" galvanized steel truss rod with a turnbuckle for adjustment.

Fastening to all terminal posts shall be with stretcher bars and fabric bands at 16" intervals. Fastening to line posts shall be tie wire or other approved method at 16" intervals.

Fastening to top rail shall be with wire ties at intervals not exceeding 20". Fastening to bottom tension wire shall be with wire ties at intervals not exceeding 2'.

8.02 CHAIN LINK FENCE INSTALLATION (Continued)

B. BASIS OF PAYMENT

Chain link fence installed in conformance with the plans and these Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per foot for CHAIN LINK FENCE, ____" for the various sizes called for in the proposal. Such payment shall be full compensation for materials, equipment, tools, labor and incidentals necessary to complete the Work as indicated on the plans.

8.03 PIPE RAILING FENCE INSTALLATION

A. GENERAL

New pipe railing fence shall be installed at the locations shown and as dimensioned and detailed on the plans. All Work shall be performed by competent and experienced fence erection workers, whose experience record is satisfactory to the City's Project Manager.

Post spacing shall not exceed 10' or shall be at intervals shown on the plans. Posts installed in concrete walls shall be set into pipe sleeves cast into the wall and shall extend a minimum of 12" into the sleeve.

Posts in walls shall be set using rigid cellular plastic foam backfill. Sufficient materials shall be placed in the pipe sleeve to completely fill the annular space to within 3/16" below the top of the sleeve. Care shall be taken to ensure that the annular space is filled in such a manner as to prevent voids in the plastic foam. Excess material shall be cut off and removed so as to leave a 3/16" reservoir. The resulting reservoir shall be filled with one-part, self-leveling polyurethane sealant installed in conformance with the manufacturer's recommendations.

The tee, cross, elbow and flange connectors shall be set such that the set screw side of the connectors shall be installed on the side opposite the pedestrian traffic.

B. BASIS OF PAYMENT

Pipe railing fence, installed in conformance with the plans and these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per linear foot for PIPE RAILING FENCE, ____". Such payment shall be full compensation for all castings, pipe, sleeves, plastic backfill, sealant, caulking, posts, rails, and connectors, materials, equipment, tools, labor and incidentals necessary to complete the Work as indicated on the plans.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 9

CRUSHED ROCK SURFACING

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CHAPTER 9

CRUSHED ROCK SURFACING

9.00 GENERAL

The Work of Crushed Rock Surfacing and of Crushed Rock Bikeway shall include the scarification of the subgrade, the furnishing, hauling, spreading and manipulating of the crushed rock and gravel.

Sources for crushed rock and gravel shall be on the latest edition of the Nebraska Department of Transportation "Gravel and Rock Producers" list unless otherwise approved by the City's Project Manager.

9.01 MATERIALS

A. CRUSHED ROCK

1. General

Crushed rock for surfacing shall consist of clean, hard particles of crushed limestone, quartzite or dolomite.

2. Gradation

Crushed rock for surfacing shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
#4	20-60
#10	0-30
#200	0-10

Crushed rock for bikeway surfacing shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
#4	85-100
#8	53-83
#16	33-53
#30	20-40
#50	16-28
#100	13-23
#200	12-20

3. Soundness

Crushed rock for surfacing shall have a percent loss of not more than 30 at the end of 16 cycles of freezing and thawing in conformance with AASHTO Method T-103.

9.01 MATERIALS (Continued)

A. CRUSHED ROCK (Continued)

4. Abrasion

Crushed rock, when tested for abrasion by AASHTO Method T-96, Grade B, shall have a percentage of wear of not more than 45%.

B. GRAVEL

1. General

Gravel for surfacing shall consist of durable particles of stone and sand.

2. Gradation

Gravel for surfacing shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
#4	61-95
#10	0-30
#200	0-6

3. Soundness

The fraction of gravel contained on the No. 16 sieve shall have a soundness loss not to exceed 10% at the end of 5 cycles, except that the material having a soundness loss greater than 10% may be accepted at the discretion of the City's Project Manager, subject to an adjustment of the quantity for which payment will be made. Soundness shall be determined in conformance with AASHTO Method T-104, using sodium sulfate (Na_2SO_4), except that the soundness loss shall be determined and reported only on the fraction of the aggregate that is retained on the No. 16 sieve.

4. Sampling

Sampling of the material shall be done in conformance with AASHTO Method T-2.

9.02 EQUIPMENT

The Contractor shall furnish adequate equipment necessary for the completion of the Work which shall include, but not be limited to, motor grader with scarifying equipment, sheepsfoot roller, pneumatic tire roller and water truck.

Each load of material shall be weighed on an approved calibrated scale. Serially numbered duplicated scale tickets shall be furnished to accompany each truck load of material to the unloading point. Scale tickets shall show the date, time, load number, total weight, tare weight, project number, destination, net weight and type of material.

9.03 ROADWAY SURFACING

A. GENERAL

In general, this construction shall include combining 3" of crushed rock in the upper layer of the subgrade and the application of a 1" gravel surface to the crushed rock base, to the widths and cross section as provided by the plans or directed by the City's Project Manager.

B. PLACEMENT AND COMPACTION

The crushed rock material shall be deposited uniformly upon an approved subgrade in straight, single or double lines, followed immediately thereafter by scarification of the rock and subgrade to produce a uniform soil-rock mixture 6" thick. The mixture shall be spread into a uniform layer and compacted using sheepsfoot roller and water as required. The gravel material shall then be delivered and uniformly spread, followed immediately by compaction using an approved roller and water as required, to the satisfaction of the City's Project Manager.

C. BASIS OF PAYMENT

CRUSHED ROCK ROADWAY SURFACING and GRAVEL SURFACING that has been completed in conformance with the Plans and Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per ton based on total weight of material delivered. No payment shall be made for materials furnished in excess of that specified in the Contract or by the City's Project Manager. Such payment shall be full compensation for all materials; hauling, spreading, scarifying, and compacting; application of water; and materials, equipment, tools, labor and incidentals necessary to complete the Work.

9.04 BIKEWAY SURFACING

A. GENERAL

In general, bikeways constructed of crushed rock shall consist of a layer of compacted, crushed rock placed on a prepared subgrade to the width, thickness, and cross section as provided by the plans, indicated in the special provisions, or as directed by the City's Project Manager.

B. BASIS OF PAYMENT

CRUSHED ROCK BIKEWAY SURFACING that has been completed in conformance with the Plans and Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per ton based on total weight of material delivered. No payment shall be made for materials furnished in excess of that specified in the Contract or by the City's Project Manager. Such payment shall be full compensation for all materials; hauling, spreading, scarifying, and compacting; application of water; and materials, equipment, tools, labor and incidentals necessary to complete the Work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 13

TRAFFIC PAVEMENT MARKING

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CHAPTER 13

TRAFFIC PAVEMENT MARKING

13.00 GENERAL

The Contractor shall use a crew experienced in the work of installing the type of pavement marking material designated and shall supply all the equipment and materials necessary for pavement preparations and the placement of the pavement markings. At least one member of the crew installing the pavement markings, or the on-site crew supervisor, shall have satisfactorily passed the examination which accompanies the training course for Traffic Control Technician or Traffic Control Supervisor offered by the American Traffic Safety Services Association (ATSSA) or the Basic Traffic Control or Advanced Traffic Control courses offered by Nebraska's local technical assistance program (LTAP). A copy of certification shall be submitted to the City's Project Manager prior to the beginning of the project.

All pavement markings shall be pre-marked by the contractor. The pre-markings shall be reviewed and approved by the City's Project Manager prior to the application of durable marking material. The Contractor shall provide 48 hours advance notice to the City's Project Manager to review the pre-markings.

All pavement markings shall be installed prior to that segment of street being opened to traffic.

Traffic lane width and other transverse dimensions on the marking plan indicate the nominal distance from the back of curb to the center of the marking line, and between centers of marking lines.

The Contractor shall field verify the pavement marking quantities required for the project prior to purchasing material. The City of Lincoln will not be responsible for the Contractor's shortage or surplus of material.

A. MATERIALS

Certificate of Compliance: The Contractor shall furnish manufacturer's certifications for each marking material to be supplied or used on the project. Certificates shall indicate compliance with the provisions of the Standard Specifications.

The City reserves the right to conduct testing to identify and determine the quality, characteristics, and uniformity of any material applied to the street surface.

Durable traffic pavement marking materials listed in this Standard Specification are materials which have a normal life of at least two years beyond application. The following materials are considered durable marking materials:

- Thermoplastic (preformed)
- Thermoplastic (molten)
- Polyurea

13.00 GENERAL (Continued)

B. INSTALLATION

All pavement markings will be installed according to manufacturer specifications, pavement marking plans and Standard Specifications unless other provisions have been made with the City Project Manager. The markings shall be installed in accordance with the Manual on Traffic Control Devices (MUTCD).

Existing pavement marking materials shall be removed prior to the installation of new pavement markings. This type of pavement marking removal is considered part of the pavement marking preparation and is not a separate pay item.

Pavement marking materials shall only be placed on properly prepared surfaces. Dirt, grease, or any deleterious materials that would reduce the adhesion of the pavement marking material to the surface of which it is being applied must be removed by the Contractor before application of the new marking material.

All pavement markings shall have a uniform cross section. The density and quality of markings shall be uniform throughout their thickness. The applied markings shall have no more than 5%, by area, of holes or voids and shall be free of blisters.

The pavement markings shall be installed at the approved pre-marked alignment. Deviation from the approved alignment shall not exceed 1 inch.

Existing pavement markings are not to be used as guides for the layout of new markings, except when the plan specifies "match existing markings."

When the temperature, humidity or other conditions exist that prevent the installation of the specified marking material, the Contractor shall install and maintain temporary paint markings or other traffic pavement markings approved by the City's Project Manager, at the Contractor's cost, until conditions are adequate for installation of permanent markings.

C. GROOVING

Asphalt surfaces: Asphalt shall not be grooved. The durable markings will be surface applied or applied in pre-existing grooves.

Concrete surfaces: Concrete shall only be grooved one time. If the surface where the marking material is to be applied is already grooved, additional grooving shall not be performed. If the markings are being installed on concrete that has not been grooved, the contractor will groove the concrete prior to installing the markings.

Grooved markings consist of the installation of marking material in grooves or recesses cut into the pavement surface to allow the material to be partially embedded below the general surface of the pavement.

The specified marking material shall be applied to the pavement surface within the grooved area following the standard installation method specified for that type of marking material.

The grooves shall be cut into the pavement with equipment designed and developed to recess grooves into pavement. The unit shall have a fully articulated head design that follows the contour of the pavement surface and ensures proper depth of the groove. All cut material shall be removed from the groove and surface of the pavement.

13.00 GENERAL (Continued)

C. GROOVING (Continued)

The pavement marking shall be placed in the grooves within 24 hours of the grooves being cut. Grooves shall be clean and dry prior to applying the pavement marking.

Grooved surfaces shall meet the following:

1. Groove width: Pavement marking width +2 inch maximum
2. Groove depth: 100 mils +/- 10 mils for 125 mils thick material
45 mils +/- 10 mils for 60 mils thick material
35 mils +/- 10 mils for 25 mils thick material
3. Groove length: Marking material length + required grooving transition
4. Groove position: 2 inches off the joint line (per plan).

D. CLEANUP

Any material used to prepare the surface for the application of markings shall be removed by the Contractor.

Any pavement marking material that is removed shall be cleaned/removed by the Contractor. Cleaning shall be by any effective method approved by the City's Project Manager, which completely and effectively removes old pavement markings, contaminants and loose materials.

No pavement marking equipment shall be purged in the public right-of-way.

13.01 REMOVAL

A. SURFACE PREPARATION

Existing traffic pavement markings which are in alignment with approximately the same location as proposed new pavement markings must be removed to the extent necessary to prepare the street surface for the installation of the new pavement marking material in accordance with these Standard Specifications and the material manufacturer's recommendations. This type of pavement marking removal is considered subsidiary to the new markings and is not a separate pay item.

Methods of pavement marking removal include grinding, scraping, sandblasting, shot blasting, high-pressure water jetting, or other methods approved by the City's Project Manager. The removal process shall not damage the pavement surface. Pavement markings shall be removed to the satisfaction of the City's Project Manager.

Any residue remaining after removal of the marking shall be collected and removed from the project by the Contractor.

B. BASIS OF PAYMENT

Payment for the removal of existing pavement markings shall be measured or counted and paid for at the contract unit price bid, per linear foot or each, as listed in Appendix A, Standard Item Description, REMOVE MKG, LINE, < 8"; REMOVE MKG, WIDE LINE, > 8"; or REMOVE MKG, SYMBOL. Such payment shall be full compensation for removing and disposing of all material, for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

13.02 PREFORMED THERMOPLASTIC

A. MATERIAL SPECIFICATIONS

1. General

These markings will be durable, skid resistant, retroreflective pavement markings suitable for use on streets or other public ways for delineation.

The markings must be a resilient white, yellow or green colored thermoplastic product, the surface of which must contain glass beads and abrasives in an alternating pattern. The markings must be resistant to the detrimental effects of motor fuels, lubricants, hydraulic fluids etc. Lines, legends and symbols are capable of being affixed to asphalt pavement and/or concrete pavement by the use of heat.

The markings must be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic when heated.

2. Approved Material

Material must be composed of an ester modified rosin resistant to degradation by motor fuels, lubricants etc. in conjunction with aggregates, pigments, binders, abrasives, and glass beads which have been factory produced as a finished product, and satisfies the requirements of the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The thermoplastic material shall conform to AASHTO designation M249, with the exception of the relevant differences due to the material being supplied in a preformed state.

a. Graded Glass Beads:

The material must contain a minimum of thirty percent (30%) intermixed graded glass beads by weight. The intermixed beads shall conform to AASHTO designation M247, with minimum 80% true spheres and minimum refractive index of 1.50.

The material must have factory applied coated surface beads and abrasives in addition to the intermixed beads at a rate of 1/2 lb. (.23 kg) [$\pm 20\%$] per 11 sq. ft. (1 sq. m). The surface beads and abrasives must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a “checkerboard” pattern of glass beads and abrasive materials. The abrasive material must have a minimum hardness of 9 (Mohs scale). The factory applied coated surface beads shall have a minimum of 80% true spheres, minimum refractive index of 1.50, and satisfy the following gradation:

Size Gradation		Retained, %	Passing, %
US Mesh	Um		
12	1700	0 - 2%	98 - 100%
14	1400	0 - 6%	94 - 100%
16	1180	1 - 21%	79 - 99%
18	1000	28 - 62%	38 - 72%
20	850	62 - 71%	29 - 38%
30	600	67 - 77%	23 - 33%
50	300	86 - 95%	5 - 14%
80	200	97-100%	0 - 3%

13.02 PREFORMED THERMOPLASTIC (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Material (Continued)

b. Pigments:

White: The material shall be manufactured with sufficient titanium dioxide pigment to satisfy FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected.

Yellow: The material shall be manufactured with sufficient pigment to satisfy FHWA Docket No. FHWA-99-6190 Table 5 and Table 6 as revised and corrected. The yellow pigments must be organic and must be heavy-metal free.

Other Colors: The pigments must be heavy-metal free.

c. Heating indicators:

The top surface of the material (same side as the factory applied surface beads/abrasives) shall have regularly spaced indents. The closing of these indents during application, shall act as a visual cue that the material has reached a molten state allowing for satisfactory adhesion and proper bead embedment, and as a post-application visual cue that the application procedures have been followed.

d. Skid Resistance:

The surface of the preformed thermoplastic material shall contain factory applied non-skid material with a minimum hardness of 9 (Mohs scale). Upon application the material shall provide a minimum skid resistance value of 60 BPN when tested according to ASTM E 303.

e. Thickness

The material must be supplied at a minimum thickness of 90 mils (2.29 mm) or 125 mils (3.15 mm).

f. Retro reflectivity:

The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of sufficient nighttime retroreflection when tested in accordance to ASTM E 1710. The applied material must have an initial minimum intensity reading of 275 mcd·m⁻²·lx⁻¹ for white. Devices used to measure the retro reflectivity of a marking shall be calibrated in accordance with the manufacturer's recommendations. Record of calibration may be requested by the City Project Manager.

Note: Initial retroreflection and skid resistance are affected by the amount of heat applied during installation. When ambient temperatures are such that greater amounts of heat are required for proper installation, initial retroreflection and skid resistance levels may be affected.

13.02 PREFORMED THERMOPLASTIC (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Material (Continued)

g. Environmental Resistance:

The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

h. Abrasives:

The abrasives and surface beads must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a “checkerboard” pattern of glass beads and abrasive materials. The abrasive material must have a minimum hardness of 9 (Mohs scale).

B. INSTALLATION METHODS

The materials shall be applied using methods recommended by the manufacturer. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry and free of debris. A primer shall be used when recommended by manufacturer.

C. BASIS OF PAYMENT

Pavement markings installed in conformance with the Plans and Standard Specifications and acceptable to the City’s Project Manager shall be measured or counted and paid for at the contract unit price bid, per linear foot or each, as listed in Appendix A, Standard Item Description, PREFORMED THERMOPLASTIC MKG, SYMBOL; PREFORMED THERMOPLASTIC MKG, RR XING ASSY; or PREFORMED THERMOPLASTIC MKG, ____" (various widths).

Such payment shall be full compensation for preparation of pavement surface, removing and disposing of all existing material, furnishing and installing marking materials, and for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

13.03 MOLTEN THERMOPLASTIC

A. MATERIAL SPECIFICATIONS

1. General

White and yellow reflectorized molten thermoplastic pavement marking material shall be of a type that is applied only to asphalt pavement in a molten state by mechanical means with surface application of glass beads which, upon cooling to under normal pavement temperature, produces an adherent reflectorized marking of specified thickness and width and capable of resisting deformation by traffic.

The material shall have resealing characteristics such that it is capable of fusing with itself and previously applied marking material of the same composition to patch worn areas of previously applied material.

The material shall not deteriorate upon contact with sodium chloride, calcium chloride, or other chemicals used to prevent formation of ice on streets, or because of the content of pavement materials, and shall be impervious to oil and grease drippings from traffic.

2. Approved Material

The composition minimum percentages by weight are shown in Table A.

Table A		
Minimum Composition Requirements		
	White Minimum Percentage	Yellow Minimum Percentage
Binder	18	18
TiO ₂ (Type 2 Rutile)	8	N/A
Glass Beads	35	35
Yellow Pigment	N/A	5.0

- a. The alkyd binder shall consist of maleic modified medium lead chromate pigment with a minimum of 50% lead-free content.
- b. The alkyd binder shall consist of maleic modified rosin ester and not more than 20% petroleum derived resin.
- c. The yellow pigment used shall be a heat established medium lead pigment with zero percent lead content.

13.03 MOLTEN THERMOPLASTIC (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Material (Continued)

d. Physical Requirements:

(1) Color:

- (a) The white thermoplastic shall be pure white and free from any tint. When tested with a Colorimeter, such as a Gardner Color Difference Meter, the material shall not show deviations from a magnesium oxide color standard that are greater than shown in Table B.

Table B

Color Deviations		
Scale Definitions	Magnesium Oxide Standard	Sample
RD Reflectance	100	75% Min.
a Redness-Greenness	0	-5 to +5
b Yellowness-blueness	0	-10 to +10

- (b) The color of the yellow thermoplastic shall visually match that of FHWA PR Color #1 when tested in accordance with ASTM D 4960. The daytime reflectance values and chromaticity coordinates shall fall within the limits in Table C.

Table C

Reflectance and Chromaticity	
Reflectance	45% Min.
Chromaticity	Shall fall in an area bounded by these coordinates:
Coordinates x,y	x – 0.470 0.493 0.516 0.490 y – 0.455 0.467 0.444 0.433

- e. **Color Retention:** The thermoplastic materials shall maintain the color values specified herein for white and yellow after the samples are prepared and subjected to an ultraviolet light source as described in ASTM D 795. A General Electric 275-watt sun lamp (Type RS) with a built-in reflector may be substituted for the light source.
- f. **Water Absorption:** The thermoplastic compound shall have no more than 0.5% by weight of retained water when tested in accordance with ASTM D 570.
- g. **Softening Point:** The compound shall have a softening point of not less than 195°F (90°C), as determined by ASTM E 28.
- h. **Low Temperature Stress Resistance:** A concrete substrate coated with a minimum of 32 square inches (206 cm²) of thermoplastic material shall be immersed in cold water for one hour; then immediately placed in an insulated cold compartment and maintained at a temperature of minus 50°F (minus 45°C) for a period of 24 hours. When removed and allowed to come to room temperature, the sample shall still adhere to the contact substrate with no cracking or flaking.

13.03 MOLTEN THERMOPLASTIC (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Material (Continued)

- i. Reheating: The thermoplastic compound shall maintain proper performance properties when heated four times to the application temperature. After heating to 425°F (218°C) for 6 hours while continually stirring at 50 to 100 RPM, the Brookfield viscosity shall not exceed 16,000 cps at 12 RPM.
- j. Safety: In the plastic state, the material shall not give off fumes which are toxic or otherwise injurious to persons or property.
- k. Specific Gravity: The specific gravity of the compound as determined by the water-displacement method shall be between 1.9 and 2.5.
- l. Drying Time: When the material is applied at 400°F (204°C), the line shall be completely solid and show no effect of tracking after 15 minutes.
- m. Indentation Resistance: The hardness shall be measured by a Shore Durometer, Type A-2, as described in ASTM D 2240. The durometer and the panel shall be at least 110°F (43°C). With a 4.4-pound (2 kg) load applied, the reading shall not be less than 45 after 15 seconds.
- n. Abrasion Resistance: The sample shall show a maximum loss of 0.0132 pound (6 g) when tested by the blasting box method.
- o. Impact Resistance: The average impact resistance of (four) separate samples shall not be less than 10.0 inch-pounds (1.13 N-m) when tested according to Method A of ASTM D 256.
- p. Sealing Primer: The particular type and the proportions used shall be as recommended by the manufacturer of the thermoplastic compound.
- q. Glass Beads:
 - (1) Refractive Index: The reflective glass beads pre-mixed into the compound and the reflective glass beads used for surface application shall have a refractive index of not less than 1.50 when tested by the liquid emersion method at 75°F (24°C).
 - (2) Roundness: Not less than 75% of the beads overall and not less than 70% of the beads retained on any specified sieve shall be true spheres when tested by ASTM D 1500.
 - (3) Heavy Metal Concentration: Glass beads shall not contain more than 75 ppm (total) of arsenic or 100 ppm (total) of lead, when tested in accordance with EPA Methods 3052 and 6010B. Other suitable x-ray fluorescence spectrometry analysis methods may be used to screen samples of glass beads for arsenic and lead.
- r. Coatings: The intermix and drop-on beads shall have an adhesion promoting coating which is specific for the thermoplastic system.

13.03 MOLTEN THERMOPLASTIC (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Material (Continued)

s. Flowing Properties:

- (1) The glass beads shall flow uniformly through dispensing equipment in atmospheric humidity up to 94%.
- (2) 0.22 pounds (0.1 kg) of glass beads, spread evenly and thinly in a suitable container, shall be conditioned at 75°F (24°C) for 4 hours over a solution of sulfuric acid (Sp. Gr. 1.10) in a closed desiccator. After 4 hours, the glass beads shall flow readily through a clean glass analytical funnel, 60 degrees, 0.20-inch (5 mm) diameter and 4-inch (100 mm) stem. Inside diameter of the stem shall be a nominal 1.4 inches (35 mm).

t. Adhesion Coating: The glass beads shall be coated with an adhesion promoting coating that is compatible with thermoplastic material and that passes the dansyl chloride test procedure.

u. Gradation: The intermixed and surface applied glass beads shall meet the gradation requirement in Table D.

Table D

Glass Bead Gradation	
<u>Sieve Size</u>	<u>Percent Passing</u>
No. 16 (1.18mm)	100
No. 20 (850 µm)	75-95
No. 30 (600 µm)	20-40
No. 50 (300 µm)	0-5
No. 100 (150 µm)	0-2

v. Application:

- (1) The surface application of beads shall be not less than 12 lbs./100 SF (0.58 kg/m²).
- (2) Properties of Finished Striping and Marking Installation:
 - (a.) The stripe shall not be slippery when wet.
 - (b.) The compound shall not lift from the pavement in freezing weather.
 - (c.) The compound shall not deteriorate by contact with sodium chloride, calcium chloride, or oil drippings from traffic.
 - (d.) After application and proper drying time, the stripe shall show no appreciable deformation or discoloration under traffic at temperatures up to 140°F (60°C).
 - (e.) The stripe or marking shall maintain its original dimensions and placement. The exposed surface shall be free from tack. Cold ductility of the material shall be such as to permit normal movement with the street surface without chipping.

13.03 MOLTEN THERMOPLASTIC (Continued)

B. INSTALLATION METHODS

1. Two weeks prior to the installation of the permanent pavement markings, the Contractor shall provide a printed copy of the material manufacturer's installation procedures to the City Project Manager.
2. The Contractor shall check the pavement surface moisture each day prior to marking application. The Contractor shall place and hold a two square foot (0.2 m²) piece of clear plastic on the existing pavement for a period of 15 to 20 minutes. Remove and hold the plastic in a vertical position. If water drips from the underside of the plastic sheet, the pavement has excess moisture, do not install the pavement marking.
3. Thermoplastic material must be installed in a molten state between 395°F and 425°F (201.66°C and 218.33°C).
4. Thermoplastic material shall be installed at a thickness of 110 mils +/- 10. The initial measurement will be made above the pavement surface. The material may slightly penetrate the pavement on fresh asphalt surfaces.
5. If the material appears to be less than 100 mils thick above the pavement surface, the line will be "chipped" and checked to determine the actual thickness. If the actual thickness is less than 100 mils, the deficient portions of the line shall be ground down to no more than 0.05 inch (1.3 mm) above the pavement surface and sufficient thermoplastic and glass beads placed over the line to bring it up to the specified thickness.
6. Unless otherwise specified, pavement markings shall be MUTCD standard size. Deviations from reasonable standards of workmanship are cause for rejection.
7. Thermoplastic pavement marking material may be installed by the Extrusion Method or Ribbon Extrusion Method.
8. Equipment used for placing markings shall be manufactured for that purpose and of sufficient size and stability to ensure a smooth and straight application.
 - a. A full-sized, truck-mounted unit capable of maintaining an operating speed of 3 to 5 mph (5 to 8 km/h) shall be required. It shall have the capability of automatically placing intermittent as well as continuous lines from either the left or right side of the vehicle. The vehicle shall be capable of applying either extrusion or ribbon thermoplastic in uniform dimensions and accurately following pavement irregularities.
 - b. The City Project Manager may allow the use of a hand-operated or small riding machine where a limited quantity of edge and lane lines are required, or for turn lanes, gore areas or other small work, provided sufficient traffic control is in place to close the lane adjacent to the marking operations.

13.03 MOLTEN THERMOPLASTIC (Continued)

B. INSTALLATION METHODS (Continued)

9. Retro reflectivity:

- a. Immediate reflectivity shall be accomplished by the application of glass beads to the surface of the marking through a gun that is located directly behind the thermoplastic applicator. The beads shall be applied into the material in a manner that will result in the surface beads being embedded to about their midpoint. Glass beads shall be applied uniformly at a minimum rate of 12 lb./100 SF (0.58 kg/m²). These beads shall be in addition to those that are provided as part of the thermoplastic mixture itself.
- b. The glass bead dispenser shall be adjustable to regulate the flow of the beads and shall uniformly dispense the glass beads over the entire width of the line.
- c. The beads shall adhere to the cured thermoplastic, or all marking operations shall cease until corrections are made.

C. BASIS OF PAYMENT

Pavement markings installed in conformance with the Plans and Standard Specifications and acceptable to the City's Project Manager shall be measured or counted and paid for at the contract unit price bid, per linear foot or each, as listed in Appendix A, Standard Item Description, MOLTEN THERMOPLASTIC MKG, ____" (various widths).

Such payment shall be full compensation for preparation of pavement surface, removing and disposing of all existing material, furnishing and installing marking materials, and for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

13.04 POLYUREA

A. MATERIAL SPECIFICATIONS

1. General

Polyurea shall be Epoplex LS 90 or approved equivalent. The markings shall be comprised of a polyurea coating adhered to the pavement surface and reflective media adhered to the polyurea coating. The polyurea coating shall consist of a mixture of high-quality resins, curing agent and pigments. The reflective media shall consist of glass beads.

The polyurea marking material shall be applied by spray method onto concrete pavement or asphalt pavement surfaces. Following an application of glass beads or black aggregate, and upon curing, the resulting marking shall be an adherent reflectorized pavement marking of the specified thickness and width that is capable of resisting deformation by traffic.

2. Approved Materials

a. Color and Weathering Resistance:

The mixed polyurea compound, when applied to a 3" x 6" aluminum panels at 15±1 mil in thickness with no glass beads or elements and exposed for 500 hours in a Q.U.V. Environmental Testing Chamber, as described in ASTM-G154, Cycle #1, shall conform to the following minimum requirements. The color of the white polyurea system shall not be darker than Federal Standard No. 595A-17778. The color of the yellow polyurea system shall conform to Federal Standard No. 595A-13538.

b. Track-Free Time (Laboratory):

When tested in accordance with ASTM D 711, the polyurea marking material shall reach a track-free condition in 5 minutes or less for a 15-mil thickness. This test shall be performed with AASHTO Type 1 beads coated at a rate of 0.099 pounds per square foot. The track-free time shall not increase substantially with decreasing temperature.

c. Adhesion to Concrete:

The polyurea coating, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified concrete surface that there shall be a 100% concrete failure in the performance of this test. The prepared specimens shall be conditioned at room temperature (75°± 2° F) for a minimum of 24 hours and maximum of 72 hours prior to the performance of the tests indicated.

d. Adhesion to Asphalt:

The polyurea coating, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified asphalt surface that there shall be a 100% asphalt failure in the performance of this test. The prepared specimens shall be conditioned at room temperature (75°± 2° F) for a minimum of 24 hours and maximum of 72 hours prior to the performance of the tests indicated.

13.04 POLYUREA (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Materials (Continued)

d. Adhesion to Asphalt: (Continued)

The polyurea coating shall be formed by the reaction of two components. Neither component shall contain appreciable amounts of dilutents. The polyurea coating shall be essentially 100% solids. Volatile content of the mixed components determined by ASTM D2369 shall be less than 2%.

The polyurea coating materials shall be manufactured without the use of lead chromate pigments or other similar, lead-containing chemicals.

The white polyurea coating shall contain not less than 20% by weight rutile titanium dioxide pigment to ensure adequate opacity, hiding power and reflective properties.

The markings shall consist of white or yellow films with pigments selected and blended to conform to standard highway colors. The daytime luminance (CAP Y) of the coating without reflective media shall not be less than 80% white and 50% yellow when tested using a spectrophotometer with a 45-degree circumferential/ 0-degree geometry, illuminant D65, and 2-degree observer angle in accordance with ASTM E1349.

The polyurea coating, when applied to aluminum panels at 20 +/- 2 mils in thickness with no glass beads, allowed to cure for at least 72 hours, and exposed in a Q.U.V. Environmental Testing Chamber, as described in ASTM G-154-00, Cycle #2 for 1000 hours, shall conform to the following minimum requirements.

The daytime color of the white and yellow polyurea systems shall conform to ASTM D6628. The daytime luminance (CAP Y) after exposure shall differ no more than 1% when compared to the initial measurement.

The polyurea pavement marking materials, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified concrete surface that there shall be a 100% concrete failure in the performance of this test. The prepared specimens shall be conditioned at 75 degrees +/- 2 degrees for a minimum of 24 hours and maximum of 72 hours prior to performance of the tests indicated.

When tested in accordance with ASTM D711, the polyurea marking material shall reach no-track condition in 10 minutes or less for a 20 +/- 2 mils thickness. This test shall be performed with AASHTO Type 1 beads coated at a coverage of 0.119 pounds per square foot.

The polyurea pavement marking materials when tested according to ASTM D2240, shall have a shore D hardness of between 70 and 100. The mixed polyurea coating, when applied to aluminum panels of 20+/-2 mils in thickness, shall be allowed to cure at room temperature for at least 72 hours before testing.

The reflective media shall be made up of glass beads for drop-on application and shall conform to the following requirements or be an approved equivalent.

13.04 POLYUREA (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Materials (Continued)

d. Adhesion to Asphalt: (Continued)

The required glass beads shall be a 60/40 blend (60% sinkers and 40% floaters) of AASHTO M 247-81 Type I gradation 1.5 index glass beads. The glass beads shall have a minimum of 70% Rounds as measured according to ASTM D1155. Crush Resistance shall be measured according to the procedures of ASTM D1213 and shall be a minimum of 30 pounds retained on US #40 Mesh.

e. Acid Resistance:

A sample of glass beads supplied by the manufacturer shall show resistance to corrosion of their surface after exposure to a 1% solution (by weight) of sulfuric acid. The 1% acid solution shall be made by adding 5.7 cc of concentrated acid into 1000 cc of distilled water.

CAUTION: Always add the concentrated acid into the water, not the reverse. The test shall be performed as follows:

Take a 1" x 2" sample, adhere it to the bottom of a glass tray and place just enough acid solution to completely immerse the sample. Cover the tray with a piece of glass to prevent evaporation and allow the sample to be exposed for 24 hours under these conditions. Then decant the acid solution (do not rinse, touch, or otherwise disturb the bead surfaces) and dry the sample while adhered to the glass tray in a 150° F (66° C) oven for approximately 15 minutes. Microscopic examination (20X) shall show not more than 15% of the beads having a formation of very distinct opaque white (corroded) layer on their entire surface.

f. On-the-road Track-Free Time:

When installed at 77° F and at a wet film thickness of 15±1 mils, the markings shall reach a no-track condition in less than 10 minutes. Track-free shall be considered as the condition where no visual deposition of the polyurea marking to the pavement surface is observed when viewed from a distance of 50 feet, after a free-rolling traveling vehicle's tires have passed over the line. The track-free time shall not increase substantially with decreasing temperature.

g. Skid Resistance:

The average initial skid resistance shall be 45 BPN or greater when tested according to ASTM E303.

13.04 POLYUREA (Continued)

A. MATERIAL SPECIFICATIONS (Continued)

2. Approved Materials (Continued)

h. Reflectance:

The initial retro reflectance averaged over many installations shall be at least 500 [(mcd)(ft-2) (fc-1)] for white and 350 [(mcd)(ft-2) (fc-1)] for yellow. The standard deviation of initial retro reflectance for many installations shall be no more than 130 [(mcd)(ft-2) (fc-1)] for both white and yellow.

The initial retro reflectance of a single installation shall be the average value determined according to the measurement and sampling procedures outlined in ASTM D 6359, using a 30-meter retro reflectometer. The 30-meter retro reflectometer shall measure the coefficient of retroreflected luminance, RL, at an observation angle of 1.05 degrees and an entrance angle of 88.76 degrees. RL shall be expressed in units of millicandelas per square foot per foot-candle [(mcd)(ft-2) (fc-1)].

The metric equivalent shall be expressed in units of millicandelas per square meter per lux [(mcd)(m-2) (lux-1)].

Contractor shall notify the City Project Manager upon completion of application of pavement markings.

B. INSTALLATION METHODS

1. General

The Contractor shall furnish equipment and apply the materials according to the following Standard Specifications.

2. Equipment

The equipment shall be capable of producing markings that meet the Standard Specifications contained herein.

The equipment shall be capable of spraying the mixed polyurea components onto the pavement surface. It shall be capable of proportioning and mixing the liquid components continuously to ensure proper cure.

The equipment shall include individual material reservoirs, or space, for the storage of both liquid components. The material reservoir for one of the parts shall be provided with a means to exclude moisture, such as nitrogen blanket or air input that has been dried with a desiccant.

The equipment shall be capable of heating and maintaining the liquid component at separate, controllable temperatures to enable proper pump loading, mixing, and spraying of the material.

The applicator may be equipped with mechanical glass bead dispensing equipment capable of dispensing glass beads with air pressure after the mixed polyurea has been applied. If the applicator is not equipped to dispense beads, an alternative means of dispensing glass beads shall be required.

13.04 POLYUREA (Continued)

B. INSTALLATION METHODS (Continued)

2. Equipment (Continued)

Equipment for applying material to the street shall be equipped with a pump stroke counter or material metering device to allow the recording of gallons of material applied through the spray gun. The Contractor shall provide this information as required and shall have the conversion factors for gallons pumped per pump stroke if necessary, as provided by the equipment manufacturer. After a measured quantity of area applied to the street is complete, this total shall be compared against the metered flow through the spray gun converted to theoretical coverage based on the recommended binder thickness provided in this Standard Specification.

At any time throughout the duration of the project, the Contractor shall provide free access to his application equipment for inspection by the City's Project Manager or a materials representative.

3. Application Conditions

The markings shall be applied per manufacturer specifications to pavement that is dry and free of moisture. The street and air temperatures shall be above 40° F and rising.

The polyurea coating shall be applied at rates to achieve 20-25 mils thickness.

The specified glass beads shall be applied onto the liquid pavement marking immediately following application of Polyurea.

The Contractor shall ensure proper proportioning and mixing of the polyurea components so that the markings are adequately hardened throughout and are free of soft uncured or "blackened" spots.

The Contractor shall ensure that the polyurea coating is well adhered to the street surface, and that the beads are well adhered to the binder. The Contractor shall ensure that the beads are properly set in the polyurea coating, evenly applied according to the specified application rates. The exposed portions shall be free of the polyurea coating material.

During the application of the polyurea material, the City's Project Manager may require the Contractor to verify application rate in conformance with the parameters required in this Standard Specification.

C. BASIS OF PAYMENT

Pavement markings installed in conformance with the Plans and Standard Specifications and acceptable to the City's Project Manager shall be measured or counted and paid for at the contract unit price bid, per linear foot or each, as listed in Appendix A, Standard Item Description, POLYUREA MKG, ____" (various widths); GROOVED POLYUREA MKG, ____" (various widths); POLYUREA MKG, SYMBOL; GROOVED POLYUREA MKG, SYMBOL; POLYUREA MKG, RR XING ASSY; or GROOVED POLYUREA MKG, RR XING ASSY.

Such payment shall be full compensation for preparation of pavement surface, removing and disposing of all existing material, furnishing and installing marking materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

13.05 PAINT

A. MATERIAL SPECIFICATIONS

Paint marking material shall be acrylic waterborne white or yellow traffic paint suitable for use as a reflective pavement marking on concrete pavement or asphalt pavement when covered with drop-on glass beads.

The paint shall not contain lead or chromium and shall have a Volatile Organic Compound (VOC) content of less than 1.25 lbs./gal.

B. INSTALLATION METHODS

1. Surface Preparation

The surface that is to be painted shall have pre-existing marking materials removed prior to the installation of the new material. Surface areas that are to receive paint markings shall be cleaned to remove dirt, grease, or any foreign material that would affect the adhesion of the paint to the pavement.

2. Procedures

Paint shall be applied to clean, dry pavement at a thickness of 15 mils when wet, which is equivalent to 16 gallons of paint applied per mile of painted 4-inch line.

Paint markings shall not be installed if pavement, air, or paint temperature do not meet manufacturer specifications or requirements. Waterborne paint may be heated to a maximum of 150° F.

3. Equipment

Longitudinal paint marking lines shall be applied with a self-propelled, riding-type line striper capable of applying solid or continuous lines and broken or skip lines at regular intervals, and capable of mechanically applying a regulated amount of glass beads directly to the wet film surface of the marking paint. The glass bead nozzles or guns shall be mounted directly behind the paint applicators.

The City's Project Manager may allow the use of a walk behind type machine with a limited quantity of markings, provided sufficient traffic control is in place.

4. Drop-on Beads

Glass beads shall be mechanically and uniformly applied to the wet paint line in the amount of 6 pounds of beads per gallon of paint applied. Beads shall be applied so that they receive maximum capture and binding by the paint.

Glass beads for use with Acrylic Waterborne Traffic Paints shall be designated as AASHTO M 247 Type I Coarse Dual-Coated moisture resistant beads.

The glass beads, as received, shall be free from clumps and lumps, shall contain no extraneous material and shall flow freely when applied to traffic paint.

The glass beads shall be highly resistant to the effects of weathering as determined by laboratory tests and field tests. The glass beads shall show good adherence to the paint and provide good night visibility throughout the useful life of the reflectorized traffic paint.

13.05 PAINT (Continued)

B. Installation Methods (Continued)

4. Drop-on Beads (Continued)

The glass beads shall allow sufficient capillary action to form a firm embedment in typical traffic paint when dropped on a freshly applied paint film of 15 ± 1.5 mils wet thickness.

Imperfections - The percentage of imperfect beads and non-glass material shall be determined by testing conducted according to AASHTO PP 74. The percentage of total imperfect beads on all sieves shall not exceed 20 percent. In addition, the glass beads shall have not more than 30 percent imperfect beads passing any sieve with the exception of sieve #80. If less than 2 percent of the beads pass the #80 sieve, the imperfect bead requirement shall not apply and the percent imperfect shall not be included when calculating the total imperfect beads. Imperfect beads are defined as ovate or otherwise non-spherical in shape; two or more beads fused together; and beads which show turbidity, pitting, scratching, surface wrinkling, internal air bubbles, or other inclusions.

Index of Refraction – The glass beads shall have an index of refraction of not less than 1.50 when tested by the liquid immersion method at 25° C according to AASHTO T 346.

Gradation – The drop-on glass beads in a representative sample shall meet the following gradation requirement when tested in accordance with AASHTO PP 74.

TYPE 1 Coarse Dual-Coated Moisture Resistant Beads		
U.S. Standard Sieve No.	Sieve Opening (millimeters)	Amount Passing (Percent)
20	0.850	90-100
30	0.600	55-80
50	0.300	5-25
80	0.180	0-5

Moisture Resistance – The glass beads shall pass the “Moisture Resistance Test” according to AASHTO T 346 Section 13.

Embedment Coating Test – The glass beads shall be tested for verification of silane presence/adhesion promoter, by performing the “Dansyl Chloride Test” according to AASHTO T 346 Section 11.

Heavy Metal Concentration – Glass traffic beads shall not contain more than 75 ppm (total) of arsenic or 100 ppm (total) of lead, when tested in accordance with EPA Methods 3052 and 6010B or AASHTO TP 106. Other suitable x-ray fluorescence spectrometry analysis methods may be used to screen samples of glass spheres for arsenic and lead.

C. BASIS OF PAYMENT

Pavement markings installed in conformance with the Plans and Standard Specifications and acceptable to the City’s Project Manager shall be measured or counted for at the contract unit price bid, per linear foot, as listed in Appendix A, Standard Item Description, PAINT MKG, ____" (various widths).

Such payment shall be full compensation for preparation of pavement surface, removing and disposing of all existing material, furnishing and installing marking materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

13.06 TEMPORARY MARKINGS

A. GENERAL

Temporary pavement markings may be used to provide guidance through construction work zones or to provide temporary pavement markings on completed streets until date, temperature, or humidity conditions allow the installation of specified permanent marking material.

Temporary markings shall be maintained until such time that conditions allow the installation of the specified permanent marking material.

When the Contractor is unable to install the specified marking material because of failure to complete the project by the original project completion date or approved extensions, the installation, maintenance, and removal of the temporary pavement markings shall be at the Contractor's expense.

B. FLEXIBLE RAISED PAVEMENT MARKER

Flexible raised pavement markers shall be made of a polyurethane body formed in an "L" shape. The marker shall be approximately 4 inches wide and the vertical portion of the marker shall be at least 1.5 inches high. The base of the marker shall be at least 1 inch deep. A cube-corner microprism reflective tape material shall be placed horizontally along both sides of the top of the vertical section of the marker. The reflective material shall be recessed in an "I-Beam" design to protect the reflective material from aggregate. A clear flexible polyvinyl chloride plastic cover is to be attached to the vertical section of the marker with a heavy-duty staple to cover the reflective material during surfacing operations. The flexible raised pavement marker must be readily visible at night when viewed with high beam automobile headlights. The marker shall be the same color as the material it is to replace or supplement. The marker shall be approved by the City Project Manager prior to use.

Flexible raised pavement markers shall be installed on the pavement surface by methods recommended by the manufacturer but shall be able to be removed by the Contractor without damage to the pavement surface.

Flexible raised pavement markers shall have a spacing of 5 feet when used as a solid line. A skip line shall consist of 3 markers spaced 2 feet apart with an 18-foot gap between sets of markers. Placement of these markers may differ if pre-approved by the City Project Manager. Flexible raised pavement markers shall be removed by the Contractor when no longer needed.

C. TAPE

Temporary pavement marking tape shall be a retroreflective plastic material suitable for use as a temporary marking on concrete pavement and asphalt pavement surfaces. The tape shall have a pressure sensitive adhesive which allows application to the pavement surface without additional adhesive. Tape intended to be removed from the pavement surface shall be capable of being removed by hand from the pavement surface intact or in large pieces at temperatures above 40° F.

D. TEMPORARY PAINT

Paint that is applied as a temporary marking shall be applied to clean, dry pavement at a thickness of 7 mils when wet, which is equivalent to 7.46 gallons of paint applied per mile of painted 4-inch line. Painted lines shall have sharply defined edges at the overall line width shown on the plan.

13.06 TEMPORARY MARKINGS (Continued)

E. BASIS OF PAYMENT

Temporary pavement markings installed in conformance with the Plans and Standard Specifications and acceptable to the City's Project Manager shall be measured or counted and paid for at the contract unit price bid, per linear foot or each, as listed in Appendix A, Standard Item Description, TEMPORARY MKG, TAPE, 4"; TEMPORARY MKG, PAINT, ___" (various widths); or FLEXIBLE RAISED PAVEMENT MARKER.

Such payment shall be full compensation for preparation of pavement surface, removing and disposing of all existing material, furnishing and installing marking materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

13.07 GUARANTEE PERIOD

Following initial completion of all pavement markings, there shall be a 1-year observation period, except for paint which shall be a 180-day observation period, during which the Contractor, at no expense to the City of Lincoln, shall replace any marking that the City's Project Manager determines is not performing satisfactorily. At the end of the observation period, the minimum required retention percentage for markings installed shall be 90% and shall meet all millicandelas requirements for retro reflectivity of material.

The percentage retained shall be calculated as the nominal area of the marking less the area loss, divided by the nominal area and expressed as a percentage of the nominal area. Zones of measurement shall be 1000 feet in street length or between intersections, whichever is shorter. Within a zone of measurement, marking retained shall be measured as follows:

Solid line of one width and color	Total length of solid line retained
Skip segments of one color	Total number of marking segments retained (each at least 90% complete)

A claim, made by the City against the Contractor, shall be submitted to the Contractor in writing no later than 30 days after the 180-day observation period for paint or a 1-year observation period for all durable markings.

Final acceptance of all marking will include an inspection of the appearance of the markings during daylight and darkness. Any markings that fail to have a satisfactory appearance during either period, as determined by the City's Project Manager, shall be reapplied at no expense to the City.

Final acceptance of the pavement marking shall be after 180 days for paint or 1 year for all other materials listed above after the initial completion of all Work, or upon completion of all corrective Work, whichever occurs last.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 14

TRAFFIC SIGNS

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CHAPTER 14

TRAFFIC SIGNS

14.00 GENERAL

All tubular markers, signs, posts and associated hardware will be purchased and installed by the City of Lincoln unless otherwise directed by the City project manager or as noted in project specific plans and specifications.

This Work shall consist of all materials and labor necessary to provide, fabricate, and install traffic signs at the locations shown on the project plan set.

Traffic signs shall conform to the requirements of the current edition of the Manual on Uniform Traffic Control Devices for Street and Highways (MUTCD), Standard Highway Signs, and the Lincoln Standard Plans (LSP's).

It shall be the Contractor's responsibility to utilize the "One-Call" system when required.

14.01 TUBULAR MARKERS

A. MATERIAL SPECIFICATIONS

Tubular markers shall be 4' in length, have a 2 1/4" outside diameter, with two, 3" (or greater) High Intensity reflective material sheets located 1" down from top and spaced 4" apart. The yellow tubular markers shall have yellow High Intensity reflective material sheets; the white tubular markers shall have silver. The base shall have a square to round adaptor. The markers shall be Shur-Tite, or equivalent.

B. INSTALLATION METHODS

Tubular markers shall be installed into square tubular marker anchors per LSP.

C. BASIS OF PAYMENT

Tubular Markers installed in conformance with the project plan set and Standard Specifications shall be paid for at the contract unit price bid per each TUBULAR MARKER. Such payment shall be full compensation for furnishing and installing materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

14.02 SQUARE TUBULAR MARKER ANCHORS

A. MATERIAL SPECIFICATIONS

Anchors shall be 2" OD, 12-gauge, galvanized steel tubing with 7/16" pre-punched holes on 1" centers on all four sides, 36" in length. Anchors shall be FHWA approved and compliant with AASHTO specifications.

B. INSTALLATION METHODS

Anchors shall be installed per LSP.

C. BASIS OF PAYMENT

Square Tubular Markers installed in conformance with the project plan sets and Standard Specifications shall be paid for at the contract unit price per each TUBULAR MARKER ANCHOR, SQUARE. Such payment shall be full compensation for furnishing and installing materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

14.03 SIGNS

A. MATERIAL SPECIFICATIONS

All blanks shall be new aluminum, meeting ASTM Specifications B209, Alloy 5052-H38 of the sizes as shown in the Standard Highway Signs and the MUTCD. The gauges shall be as follows:

- Signs less than 4 square feet shall be 0.063 inches thick
- 4 square feet to less than 9 square feet shall be 0.08 inches thick
- 9 square feet or greater shall be 0.10 inches thick.

Overhead signs 18" in height or greater shall be 0.125 inches thick, with 2 1/2" radius corners.

All signs shall be smooth and free of burrs. Both sides of the blank shall be treated with an Alodine 1200 process or approved equivalent.

Reflective sheeting shall be applied without visible seams or joints. Reflective sheeting shall be mechanically applied as per manufacturer's recommended procedures and equipment.

Reflective background sheeting shall meet the MUTCD requirements of ASTM D4956 and the following additional minimum requirements:

- Post-mounted signs: ASTM Type IV prismatic sheeting
- Overhead signs and pedestrian/school crossing (fluorescent yellow green) post-mounted signs: ASTM Type IX

Sheeting shall be applied to sign blanks using Class 1 adhesive.

The message shall be either directly applied, screened, or digitally printed on the sign face, in the colors, size, and layout specified in the plan set and in conformance with Standard Highway Signs.

14.03 SIGNS (Continued)

B. INSTALLATION AND REMOVAL METHODS

Signs installed on square tubing will be mounted in such a way that none of the post protrudes above the sign. If using a utility pole, approval must be received from the appropriate pole owner to install a sign.

All signs that are installed shall display the year (YYYY) the sign was installed on the back of the sign. These numbers shall be black and shall have a minimum height of 3/4". These numbers shall be applied in paint, using a stencil or by other methods approved by the City's Project Manager.

All signs that are installed shall have a fabrication date of no more than 6 months prior to the installation date and shall not have been used previous to this installation.

If more than one sign is installed on the same mounting device, the signs shall be installed so that the widest sign is on top and the narrowest sign is on the bottom.

The removal of the existing signs shall be coordinated with the City of Lincoln, Traffic Engineering Division to assure required signs are in place during all construction phases. These traffic signs, posts and fastening hardware shall be returned to 901 W. Bond Street, Door Y. All material damaged during removal, relocation, storage or reinstallation shall be repaired or replaced by the Contractor at their expense. The Contractor is responsible to prove if any material was damaged prior to removal.

C. INSPECTION AND WARRANTY

Each sign installation will be inspected by the City of Lincoln. If a sign does not meet the standards and specifications in this document, MUTCD, or LSP, it shall be replaced and/or relocated at the Contractor's expense.

All Street Name sign layouts shall be reviewed and approved by City of Lincoln, Traffic Engineering Division prior to fabrication.

D. BASIS OF PAYMENT

Signs shall be paid for at the contract unit price bid based on size as listed in Appendix A, Standard Item Description. These bid amounts shall be full compensation for installation of the new sign, hardware, and all labor, equipment, tools, materials, and incidentals necessary to complete the work.

Removal of signs shall be paid for at the contract unit price bid, REMOVE TRAFFIC SIGN ONLY or REMOVE TRAFFIC SIGN AND POST based on unit price for each assembly. Multiple signs on a single post shall be considered one assembly. This bid amount shall be full compensation for removing existing signs, posts, connecting and mounting hardware, and for all labor, equipment, tools, materials, and incidentals necessary to complete the work in accordance with the plans and these Standard Specifications.

Signs relocated during construction shall be subsidiary to the project. Any temporary signs needed throughout the project shall be the responsibility of the Contractor. All signs shall be reinstalled in the same location where they existed prior to removal unless plans show otherwise.

14.04 SQUARE SIGN POSTS

A. MATERIAL SPECIFICATIONS

Posts shall be 2" OD, 14-gauge, galvanized steel tubing with 7/16" pre-punched holes on 1" centers on all four sides. Posts shall be FHWA approved and compliant with AASHTO specifications. Post lengths shall be determined by the size of the sign that is to be placed on the post in order to achieve MUTCD height requirements.

B. INSTALLATION METHODS

Posts shall be installed per LSP.

C. BASIS OF PAYMENT

Sign posts installed in conformance with the project plan set and Standard Specifications shall be paid for at the contract unit price per each SIGN POST, 2" SQUARE. Such payment shall be full compensation for furnishing and installing materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

14.05 SQUARE SIGN POST ANCHORS

A. MATERIAL SPECIFICATIONS

Post anchors shall be 2 1/4" OD, 12-gauge, galvanized steel tubing that is 36" length with 7/16" pre-punched holes on 1" centers on all four sides. Post anchors shall be FHWA approved and compliant with AASHTO specifications.

B. INSTALLATION METHODS

Post anchors shall be installed per LSP.

C. BASIS OF PAYMENT

Sign post anchors installed in conformance with the project plan set and Standard Specifications shall be paid for at the contract unit price per each SIGN POST ANCHOR, 2 1/4" SQUARE. Such payment shall be full compensation for furnishing and installing materials, and for all labor, equipment, tools materials, and incidentals necessary to complete the Work.

14.06 SQUARE SIGN POST ANCHOR REINFORCEMENT SLEEVE

A. MATERIAL SPECIFICATIONS

Sign post anchor reinforcement sleeves shall be 2 1/2" OD, 12-gauge, galvanized steel tubing that is 18" length with 7/16" pre-punched holes on 1" centers on all four sides. Post anchors shall be FHWA approved and compliant with AASHTO specifications.

B. INSTALLATION METHODS

A reinforcement sleeve shall be attached to the upper portion of the sign post anchor as per LSP.

C. BASIS OF PAYMENT

Sign post anchor reinforcement sleeves shall be subsidiary to sign post anchors and shall not be paid for separately.

14.07 MOUNTING AND HARDWARE

A. 2" SQUARE TUBE SIGN POSTS

The Contractor shall use 5/16" stainless steel bolts and hardware. A nylon washer shall be placed between the stainless-steel washer and the sign face.

B. STREET NAME SIGN ASSEMBLY

The Contractor shall refer to the LSP to install the Street Name assembly.

If there is not a "Stop" or "Yield" sign below the assembly, the top sign shall be the North/South street. If there is a "Stop" or "Yield" sign below the assembly, the bottom sign should align with the "Stop" or "Yield" sign. When installing three signs, the signs shall alternate, with each sign being perpendicular to the next.

C. WOOD POLES

Signs shall not be installed on poles with climbing pegs.

Identification (tag) on pole shall not be covered by the sign or mounting hardware.

The Contractor shall use 2" by 5/16" stainless-steel lag bolts and stainless-steel washers. A nylon washer shall be installed between the lag bolt and the sign face. A street name bracket, as shown in the LSP, shall use a 5 inch by 3/8-inch cadmium plated lag bolt.

D. OTHER POLES

The Contractor shall use stainless steel Band-It banding, 3/4" by 0.03 inch, Part No. C206, or approved equivalent. Stainless steel Band-It Buckles, Part No. C256, or approved equivalent shall also be used. The sign shall be secured to the banding with stainless steel Band-It Flared Leg Brack-It, Part No. D021, and its supplied stainless-steel bolt or approved equivalent. Only stainless-steel material shall be allowed.

E. BASIS OF PAYMENT

All mounting materials used are subsidiary to installing the sign and shall not be paid for separately.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 15

TRAFFIC CONTROL

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CHAPTER 15

TRAFFIC CONTROL

15.00 GENERAL

This Work shall consist of furnishing and maintaining in place all barricades, warning signs, lights, and other safety devices required to protect the Work, divert traffic, warn of open excavations, and other areas or conditions which might be hazardous or dangerous during daylight or darkness.

The Contractor shall maintain traffic during construction and provide, install, maintain and remove all traffic control devices in conformance with these Standard Specifications, the Project Special Provisions, the City of Lincoln Traffic Control Guidelines for Street Construction, Maintenance and Utility Operations (LTCG), the ordinances and regulations of the City of Lincoln, the Manual on Uniform Traffic Control Devices (MUTCD), the standards of the American Disabilities Act (ADA) and the approved Traffic Control Plan (TCP). Failure of the Contractor to erect and maintain approved traffic control devices shall be reason to suspend the Work.

There shall be no lane closures on any Arterial Street during peak hours (7:00-8:00 AM and 3:30-6:00 PM) or from noon the day before to noon the day after a University of Nebraska home football game, without prior approval from Public Works and Utilities Department. The Contractor shall strictly adhere to all time limits and other restrictions as specified.

The Contractor shall utilize complete and proper traffic controls and traffic control devices, as per ADA and MUTCD requirements, during all operations. Signs for temporary operations shall be removed from view during periods of inactivity. When not in use, all temporary traffic control devices shall be removed from the public right-of-way. Any temporary traffic control devices within the public right-of-way and not in use for more than 36 hours, may be removed by the City and will be held until the costs of their removal are reimbursed by the Contractor. The Contractor is required to maintain the project in a manner that is safe to the traveling public.

Pedestrian and ADA access shall be maintained throughout the period the construction or maintenance activity disrupts or causes the closure of existing sidewalks, curb ramps or crosswalks. Safe, clearly marked routes shall be maintained through or around the construction activity at all times. The use of temporary walkways with width, slope, and cross-slope compliant to ADA Standards shall be incorporated on the job site. Surfaces must be firm (non-granular), stable, and slip resistant. Channeling and barricading shall be used to separate pedestrians from traffic when pedestrians and traffic share the street. Special attention shall be given to placing barricades to prevent visually impaired pedestrians from entering work zones and provide a detectable route.

Alternate pedestrian circulation routes shall have signage to clearly and safely direct pedestrians along a temporary or alternate path. The alternate circulation path shall have a minimum width of 3' (5' in central business district) and parallel the disrupted pedestrian access route when practicable. Barricades and channelizing devices shall comply with the current MUTCD. A solid toe rail shall be attached such that the bottom edge is 6" maximum above the walkway surface. The top rail shall be parallel to the toe rail and shall be located 36" minimum and 42" maximum above the walkway surface. If drums, cones, or tubular markers are used to channelize pedestrians, they shall be located such that there are no gaps between the bases of the devices in order to create a continuous bottom, and the height of each individual device shall be no less than 36".

Unless otherwise approved by the City's Project Manager, the Contractor shall only close existing ramps or sidewalk on one side of the street at a time so that the walk on the opposite side of the street can be used as the detour route. Sidewalk, ramps and curb must be poured back within ninety-six (96) hours after removal, unless granted additional time by the City's Project Manager. The Contractor shall minimize their construction area so that disruption to pedestrians and existing vegetation and/or landscaping in the park space area will be held to a minimum.

15.00 GENERAL (Continued)

The Contractor shall erect and maintain temporary “No Parking” signs, supplied by the City if needed. No direct payment will be made for the above work, it is considered subsidiary to other items for which direct payment is made.

15.01 TRAFFIC CONTROL SUPERVISOR (TCS)

Before Work begins on a project, the TCP shall designate in writing an International Municipal Signal Association (IMSA) or American Traffic Safety Services Association (ATSSA) Certified Traffic Control Supervisor (TCS) to be responsible for the traffic control on the project. The Contractor shall designate a TCS who shall perform the Traffic Control Management and shall be responsible for maintaining all Traffic Control Devices in compliance with the TCP.

The Contractor shall have a TCS available 24 hour per day. The Contractor shall furnish to the City the name and telephone number of the TCS responsible for emergency service. The Contractor shall maintain a 24 hour, 7 days a week (including weekends and holidays) emergency service to remove, install, relocate, and maintain warning devices.

In the event the TCS does not respond immediately or the City deems it necessary to call out other forces to accomplish emergency services, the Contractor shall be held responsible for the cost of such emergency services.

The Traffic Control Supervisor's duties shall include, but not be limited to:

- Preparing, revising, and submitting the TCP as required.
- Direct supervision of certified flaggers. Documentation of all certifications shall be sent to the City's Project Manager.
- Coordinating all Traffic Control operations, including all Contractors, Subcontractors and suppliers.
- Coordinating project activities with appropriate police and fire control agencies.
- Maintaining a project Traffic Control Diary which shall become a part of the project records.
- Inspecting all traffic control items prior to installation to ensure that the materials meet the plan and specification requirements.
- Inspecting the installation of the traffic control devices at least twice each calendar day, to determine that they are being properly maintained and cleaned. During these inspections, it is important that the Contractor has covered or removed all traffic control devices that are no longer needed or are no longer applicable. More frequent inspections may be required due to inclement weather; vandalism; or other times when more frequent inspections are warranted.
- Reporting to the City's Project Manager in writing, all known traffic incidents which occur on the project. The TCS shall, to the best of his/her ability, analyze the circumstances involved in the incidents and advise the City's Project Manager of recommended changes in the TCP. An effort will be made by the City's Project Manager to obtain accident reports prepared by law enforcement officers having jurisdiction in the project area.

15.02 TRAFFIC CONTROL PLAN (TCP)

The Traffic Control Plan (TCP) shall be prepared by a Traffic Control Supervisor (TCS) and shall include detailed drawing(s), showing all traffic control devices or reference to a standard drawing found in the LTCG or the MUTCD. The TCP shall meet or exceed the LTCG, ADA and MUTCD, provided the referenced standard drawing properly depicts the Work area and completely addresses the needed traffic control. The TCP shall consider, but not be limited to, the following items:

- Signing, Barricades, Drums, Cones, Dynamic Message Boards, and/or any other traffic control devices.
- Worker protection and safety.
- Minimizing delays and economic impacts to traffic.
- Pedestrian protection and safety.
- Meet ADA requirements
- Construction scheduling and hours of Work.
- Flagging.
- Methods and devices for delineation and channelization.
- Placement and design of barriers and barricades.
- Storage of equipment and materials.
- Removal of construction debris.
- Length of time for lane closures.
- Access for emergency vehicles.
- Clear roadside recovery areas.
- Movement of construction equipment.
- Length of project under construction at any one time.
- Methods of minimizing construction time consistent with safety.
- Construction Speed Zones.
- Modification of the above-noted items as well as any other related items under conditions of darkness or inclement weather.
- Congestion and Incident management techniques.

The Contractor shall submit a signed TCP in writing and/or drawing for review by the City a minimum of one (1) week prior to the pre-construction meeting. No phase of construction shall commence until the TCP has been reviewed by the City. The TCP shall not be revised without prior approval of the City's Project Manager. TCP revisions shall be submitted a minimum of five (5) City business days prior to implementation.

TCPs shall include detailed signing, barricading, pedestrian and traffic detouring information for each phase or stage of construction including as a minimum: type and number of devices, working hours, number and location of flaggers, and time restrictions.

Copies of the approved TCP shall be available on-site at all times. The Contractor shall provide (4) copies to the City's Project Manager.

The Contractor shall not exceed the work limits specified for each phase or stage of construction, unless approval to do so is granted by the City's Project Manager.

Should the Contractor fail to maintain the work within the specified limits, the City's Project Manager shall direct that all operations be suspended until the work is returned to the specified limits. Any costs incurred by the Contractor due to such suspension shall be at the Contractor's expense with no additional compensation or time extensions.

The Contractor shall provide any project status changes or updated information to the City's Project Manager on a daily basis.

15.03 TRAFFIC CONTROL DIARY (TCD)

A Traffic Control Diary (TCD) is a daily record of events for the project. The daily entries shall be signed by the Traffic Control Supervisor making the entry. The TCD shall be a complete record of devices and traffic control sets used, as well as documenting any issues or concerns arising in connection with the flow of traffic or pedestrians through the work zone.

The TCD shall be a hardbound book. The following information shall be placed on the cover: project name and number; General Contractor's name, TCS's name and the company providing traffic control.

As a minimum, the following information shall be recorded during the daily entries into the TCD: name of the traffic control inspector; time and date of daily inspections; TCP being used; street and sidewalk conditions; construction activity occurring; a list of devices in place; any permanent or temporary signing changes made; any permanent or temporary pavement marking changes made; names of flaggers and why they were used; a log of devices that were cleaned, maintained and/or replaced; conversations regarding traffic control; any calls requiring a work site visit and actions taken; incidents that occur within the work zone, including time, a description of what happened, a police case number, and any action that was taken in regard to the traffic control; and any law enforcement occurring within or adjacent to the work zone.

At the completion of the project, the TCD shall be given to the City's Project Manager as a record of the traffic control on the project. The TCD shall be provided prior to final payment being made.

15.04 TRAFFIC CONTROL DEVICES

The Contractor shall take all necessary precautions for the protection of the Work and the safety of the public. The initial placement, replacement, and removal of the lane dividers and other traffic control devices shall be done with extreme care and consideration for the traveling public, including bicycles and pedestrians, as shown in the plans. The Contractor shall be alert at all times to any and all deficiencies in the placement and maintenance of any traffic control devices and shall take immediate action to correct any deficiencies.

Prior to commencing Work in the vicinity of any existing Traffic Control Devices, the Contractor shall coordinate with the Traffic Operations Section for devices which need to be removed or relocated to accommodate the Work. The Contractor shall store all devices in a safe and secure manner throughout the period of Work and assume responsibility for temporary devices if necessary. Existing traffic control devices shall not be removed without the City's Project Manager's approval.

The Contractor shall remove conflicting permanent pavement markings as shown in the plans or as required by the City's Project Manager. Temporary markings no longer needed shall be removed prior to opening to traffic.

Upon completion of the contracted Work the Contractor shall reinstall the existing signing and pavement markings as approved by the City's Project Manager. Any Traffic Control Devices damaged during removal, relocation, storage, or reinstallation shall be repaired or replaced by the Contractor at their expense. The Contractor is responsible to document the condition of all existing devices prior to removal.

The removal, relocation, storage, and reinstallation of existing devices shall not be paid for separately, but shall be considered as incidental to the project.

15.04 TRAFFIC CONTROL DEVICES (Continued)

The Contractor shall maintain complete visibility of signs, barricades, and other warning devices at all times. All lights on traffic control devices shall be turned on during periods of darkness. Lenses shall be kept clean, and light intensity shall be such that the device is visible as per MUTCD. Sand bags shall be used at all times to secure devices in a position for the public to observe.

15.05 DYNAMIC MESSAGE SIGNS (DMS)

A. GENERAL

The Contractor shall be required to furnish, install and maintain Dynamic Message Signs (DMS) to alert traffic to the construction and traffic configuration during the various construction phases of the project. The DMS will be placed a minimum of 5 calendar days in advance of the disruption or shifting of traffic through the work zone or as directed by the City's Project Manager. The signs shall be left up for at least 3 calendar days once construction has begun to inform the public of the current traffic configuration. Sign placement shall be shown on the TCP for each phase of the construction and must be approved by the City's Project Manager. All messages displayed on the signs shall be approved by the City's Project Manager.

The Contractor shall check messages at least twice per day to verify the message is readable and accurate. The Contractor shall check messages each night or in time of darkness, to verify the message is readable and accurate.

Protection of the public from the DMS to comply with the LTCG and MUTCD when used in or near the street. High visibility cones shall be placed at each corner of the DMS when used behind the curb.

B. BASIS OF PAYMENT

DYNAMIC MESSAGE SIGN shall be a fixed cost item and will be paid at the set contract unit price per day for each item. Such payment shall be full compensation for furnishing, placement, maintenance, removal, high visibility cones, and all other incidentals required to provide a fully operational DMS.

15.06 TRAFFIC CONTROL FLAGGING

IMSA or ATSSA Certified flaggers are required.

Traffic movements through temporary lane closures on streets with one lane, two-way traffic shall be controlled by flaggers. In situations where sight distance is limited, the Contractor shall provide additional means of controlling traffic, including, but not limited to, two-way radios, pilot vehicles, or additional flaggers. Flaggers shall position themselves appropriately and according to MUTCD flagging procedures.

Flagger(s) shall be used when any construction equipment or personnel may occasionally encroach upon street. Flagger(s) shall be used when equipment is moving in or out of work zones.

Flagger(s) shall be properly attired with vest, head gear and stop/slow paddles. They shall be provided properly installed advance warning signs, and they shall be otherwise equipped in conformance with the requirements of the MUTCD.

15.07 ACCESS TO ADJACENT PROPERTIES

The Contractor shall notify all affected adjacent properties a minimum of 48 hours prior to restricting normal access from public streets to adjacent properties. The Contractor shall inform each resident and/or property owner of the nature of the access restriction, the approximate duration of the restriction, and the best alternate access route for that particular property. Any closure of access to or from adjacent property shall be submitted to the City's Project Manager and approved prior to implementation. The Contractor shall minimize the duration of access restrictions.

15.08 PUBLIC USE OF RIGHT-OF-WAY

Before opening any portion of the public right-of-way to vehicles or pedestrians, the Contractor shall provide a hard-surfaced route and set all necessary approved traffic control devices.

15.09 BASIS OF PAYMENT

Payment for Traffic Control and Work Zone Safety items shall be made either under the lump sum or each per day pay item.

A. LUMP SUM

TRAFFIC CONTROL FOR CONSTRUCTION shall be paid for at the contract unit price bid per lump sum. The Contractor shall be responsible for determining the Traffic Control needs for the project, including all devices and personnel, and to develop the bid amount accordingly. This payment includes the TCS, the TCD, the TCP, set-up, maintenance, removal, and any traffic control devices required. Payment shall be made as a percentage of the Traffic Control Lump Sum amount equal to the percent-complete-to-date of the balance of the total contract amount. In no case shall the total amount paid for Traffic Control exceed the Lump Sum shown in the bid schedule. Payment is full compensation for all Work prescribed in this section.

B. EACH PER DAY

When Traffic Control is bid on the Each Per Day method, individual traffic control items will be paid for based on the maximum number of each device used during the course of the day's construction work. These amounts shall include the cost of the TCS, the TCD, the TCP, set-up, maintenance, and removal. Traffic Control must be installed in conformance with the plans or as directed by the City's Project Manager.

The quantity of items for payment shall be the number of devices in place multiplied by the number of calendar days that the respective devices are in place. A calendar day for traffic control devices shall be defined as the 24-hour period from midnight to midnight, or any portion of it, when the device is installed and maintained.

Payment will not be made for those calendar days when devices are not in use, such as for folded signs, temporarily covered signs, signs temporarily positioned so that the message is not readable by the traveling public or devices placed along the street that are not necessary for proper traffic control.

Payment for any traffic control device paid for by the day will not extend beyond the last working day or calendar day allowed by the contract. Payment will be made for any approved extension of the contract time allowance. Beyond the end of the contract time and any extensions, the traffic control devices paid by the day that are required shall remain in service at no cost to the City.

15.09 BASIS OF PAYMENT (Continued)

B. EACH PER DAY (Continued)

Each sign shall be paid for separately, even if more than one sign is installed on the same post or device. Signs shall be classified and paid for based on area of the sign face:

SMALL WORK ZONE SIGN is less than 4 square feet,
MEDIUM WORK ZONE SIGN is 4 square feet to less than 9 square feet,
LARGE WORK ZONE SIGN is 9 square feet or greater.

The price for work zone signs shall include posts, mounting hardware, banding material or anything else needed to accomplish the Work.

Type II Barricade shall include the use of reflectorized drums or vertical panels and shall be counted and paid for at the contract unit price bid per each per day for TYPE II BARRICADE. Vertical panels will be paid at ½ the contract unit price for Type II Barricade. Lighting on barricades is required and included in the cost of barricades.

Type III barricades in place and positioned as shown in the plans or as directed by the City's Project Manager shall be counted and paid for at the contract unit price bid per each per day as TYPE III BARRICADE. Lighting on barricades is required and included in the cost of barricades.

FLASHING ARROW PANELS are measured by each calendar day they are in use.

Warning Lights shall not be measured separately but shall be subsidiary to the device with which they are installed.

FLAGGING will be measured for payment for each flagger location per day. Operation of one flagger for 4 hours or less will be considered as 1/2 day and operation for more than 4 hours will be considered as one full day. This price shall be full compensation for furnishing properly trained, attired, and equipped flaggers, for furnishing, installing, maintaining and removing proper signs per flagger situation and for all labor, tools, equipment, material, and incidentals necessary to complete the Work.

CONCRETE PROTECTION BARRIER is measured by the length in feet based on the nominal length of the individual units. RELOCATE CONCRETE PROTECTION BARRIER applies to repositioning the concrete protection barrier for subsequent phases of construction and shall be measured by the length of the concrete barriers relocated based on the nominal length of the individual units.

EXISTING PAVEMENT MARKING REMOVAL shall be measured by the linear foot along the line for each existing permanent (not "temporary") line removed.

TEMPORARY PAVEMENT MARKINGS ____" shall be measured by the linear feet of each line applied. Gaps are not measured for payment. Maintenance of temporary pavement markings is subsidiary to the appropriate pay item. Maintenance includes replacement of lines worn by traffic or covered by surfacing material or any other substance. The City's Project Manager will determine when the lines are no longer effective and direct the Contractor to replace the lines at no additional cost to the City. Temporary marking removal is subsidiary to the pay item.

15.09 BASIS OF PAYMENT (Continued)

B. EACH PER DAY (Continued)

Grabber Cones 42" in height shall be counted and paid for at the contract unit price bid per each per day as GRABBER CONE, 42". The repositioning, re-attachment, maintenance, removal and/or replacement of a cone shall be subsidiary.

Tubular Markers 42" in height shall be counted and paid for at the contract unit price bid per each per day as TUBULAR MARKER, 42". The repositioning, re-attachment, maintenance, removal and/or replacement of a tubular marker shall be subsidiary.

15.10 NON-COMPLIANCE

Failure to comply with any of the requirements for safety and traffic control of this contract shall result in suspension of Work and/or Payment Reduction for Non-Compliance. The Contractor may be given notice, either written or verbal, of failure to install, replace, remove, or maintain a traffic control device. Upon notification by the City's Project Manager, the Contractor shall respond to any site and take immediate steps to correct the deficiency.

Failure to install, replace, remove, or maintain a device in a timely manner as determined by the City's Project Manager shall result in no payment being made for any traffic control devices on the project until the requested installation, replacement, removal, or maintenance is performed. The City's Project Manager may also suspend all other Work until the problem is corrected. The City's Project Manager may elect at any time to correct a traffic control deficiency and bill the Contractor for all costs necessary to correct the problem.

Any action on the part of the Contractor which results in non-compliance with the approved TCP and/or the requirements of this section may be cause for reduction in payment. Non-compliance shall include failure to have the TCP on the job site at all times and failure to be able to produce the TCP upon request.

The payment shall be reduced by an amount equal to the Traffic Control Lump Sum amount divided by the total number of contract days as stated in the bid documents multiplied by the number of days when the Contractor is not in compliance with the approved TCP and/or the requirements of this section. In no case shall the amount of the reduction in payment per day be less than 1% of the total contract amount for Traffic Control.

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CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

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CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 20

CONSTRUCTION FOR UTILITIES AND STRUCTURES

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	B. SUSPENSION OF WORK	2017
20.13	SUBSTANTIAL COMPLETION	2017
20.14	FINAL ACCEPTANCE	2017
20.15	GUARANTEE	2017

CHAPTER 20

CONSTRUCTION FOR UTILITIES AND STRUCTURES

20.00 GENERAL

Construction for utilities and structures shall include the excavation and backfill of all materials necessary to complete the Work in conformance with the plans and these Standard Specifications; all necessary sheeting, shoring and bracing; and any pumping that may be necessary to keep the trench free from water. Construction for utilities and structures shall also include the removal and replacement of pavement, driveways and sidewalks; disposal of surplus materials, borrow, maintenance and protection of excavation, and the restoration of all surfaces to a satisfactory condition.

These Standard Specifications shall apply to all utility and structure work regardless of the type of Work being performed.

20.01 MATERIALS

The following materials are approved for use in the City of Lincoln pursuant to the Standard Specifications described herein. Alternate materials maybe requested in writing to the Director of Public Works and Utilities.

A. SMOOTH STEEL PIPE CASING

Smooth steel pipe used for encasement shall be of the diameter, length, and wall thickness shown on the Plans. The encasement shall be new welded steel pipe conforming to ASTM Designation A 139, Grade B. All joints shall be welded.

B. CORRUGATED METAL PIPE

Corrugated metal pipe used for encasement shall be copper steel galvanized and shall conform to the requirements of AASHTO “Standard Specifications for Corrugated Metal Culvert Pipe”, Designation M-36, and shall be of the diameter, length and gauge as shown on the Plans.

C. FOUNDATION

Foundation material shall conform to the requirements of ASTM “Standard Specifications for Concrete Aggregates”, Designation C-33. The gradation for foundation material shall be size Number 357 (2" to #4).

D. BEDDING

For Lincoln Water System and Lincoln Wastewater System projects, bedding material shall be a well graded “crusher run” crushed rock with a percent passing gradation range of 1" - 100, #4 - 20 to 60, #10 - 0 to 30 and #200 - 0 to 10, unless otherwise designated on the plans or Special Provisions or approved by the City’s Project Manager.

For Lincoln Watershed Management projects, limestone rock and crushed concrete will also be permitted, provided that the gradation range requirements listed above are satisfied.

20.01 MATERIALS (Continued)

E. GROUT

The grout shall be mixed in the volumetric proportions of 2 parts Portland cement, 1 part fly ash, and not to exceed 6 parts sand. Enough water shall be used to produce a pumpable grout.

F. FLOWABLE FILL

Flowable fill material shall meet the requirements of Chapter 3 of these Standard Specifications.

20.02 EARTHWORK

A. CLEARING AND GRUBBING

Clearing and grubbing shall be accomplished as provided in Chapter 2 of these Standard Specifications.

B. TREE REMOVAL

The removal of trees and stumps shall be accomplished as provided in Chapter 2 of these Standard Specifications.

C. EXCAVATION

In general, all excavation shall be made by open cut from the surface of the ground and at the width and to the depth necessary for the proper construction of the utility and its appurtenances, according to the plans and these Standard Specifications. The Work shall be performed in conformance with Occupational Safety and Health requirements. Nothing contained in these Standard Specifications or Contract Documents shall relieve the Contractor from complying with any Local, State, or Federal safety requirements. The Work shall be performed within the limits of construction as shown on the plans. All necessary precautions must be made to prevent slides and cave-ins. Bracing or sheeting, shall be provided to maintain the sides and bottom of the trench in unstable material.

The excavated material shall be handled in such a manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to public and private property along the line of Work. If a utility excavation is to remain open overnight in the built environment, all material (spoil) excavated, shall be properly covered and protected. If the excavation is to remain open for more than five (5) business days, all excavated material shall be removed from the job site. If excavating and backfilling on the same day, all unsuitable material (spoil) shall not be used for backfill. It shall be the Contractor's responsibility to secure the necessary permission and make all necessary arrangements for all required storage, borrow, and disposal sites.

Access shall be provided at all times to fire hydrants and water valves in the vicinity of the Work and firefighting equipment shall have access to any structure at all times. Trenches shall not be opened more than 100' in advance of the installed utility or as directed by the City's Project Manager. All trenches shall be backfilled as soon as practical after the pipe is in place, or as ordered by the City's Project Manager. Unless otherwise specified or authorized by the City's Project Manager, all excavated material shall be placed on the street side of the trench.

20.02 EARTHWORK (Continued)

C. EXCAVATION (Continued)

Holes for pipe bells shall be provided at each joint, but shall be no larger than necessary for joint assembly and assurance that the pipe barrel will lie flat on the trench bottom. Other than the bell holes, the trench bottom shall be true and even in order to provide support for the full length of the pipe barrel.

Excavation below subgrade with subsequent refilling with loose earth will not be permitted. Should the Contractor inadvertently excavate below subgrade, such over excavation shall be filled and brought up to grade with compacted soil, crushed rock, or sand or gravel as approved by the City's Project Manager.

The width of the utility trench at the top of the pipe shall be no greater than the width specified in the standard bedding details. Excessive trench width may be cause for providing a higher class bedding at no cost to the City. The width of excavation for utility lines 6" or greater in diameter shall be a minimum of 3'. In no case shall the excavation be less than 2' greater than the outside diameter of the pipe or the outside dimensions of the structure to be built. The bottom of all excavations shall be finished to the true profile grade, of full width, and cleared of any rocks, clods, roots, or other material that may interfere with properly placing the pipe or structure.

No measurement or direct payment will be made for any excavation required as part of the Work. The costs of excavation will be considered subsidiary to other items for which direct payment is made.

D. BACKFILL

Backfilling and compaction of excavations shall follow as closely after the construction as possible. All excavations shall be backfilled with approved material up to the original surface of the ground unless otherwise indicated on the plan. No backfill shall be made with material containing stone, large clods, frozen earth or debris of any kind. The backfill shall be placed in loose lifts not to exceed the thickness required to attain 12" thick compacted layers or as noted in a geotechnical report signed and sealed by an Engineer registered in the State of Nebraska.

Backfilling shall not be done in freezing weather, except by permission of the City's Project Manager, nor shall any fill be made where the material already in the trench is frozen. If construction proceeds at any time when frozen material is encountered and frozen material is placed in the trench line, all such trenches shall be re-compacted in the spring after frost conditions are no longer present in the ground. This re-compaction of the trench shall include the removal of all material to a depth of 12" below the depth of the frozen material and the replacement and re-compaction of the trench to the proper grade with suitable material.

Care shall be exercised in backfilling so as not to damage any finished Work. The backfill shall be brought up evenly on both sides of the utility or structure.

Backfilling against any concrete structure shall not be started until test specimens of the concrete develop a compressive strength of at least 2000psi.

Unless otherwise directed by the City's Project Manager, compaction of backfill within 3' of all structures and utility appurtenances, including but not limited to, valves, hydrants, manholes, and inlets, shall be accomplished by mechanical compaction using hand operated tampers, rammers, or other approved devices for the soil type(s) encountered.

20.02 EARTHWORK (Continued)

D. BACKFILL (Continued)

Jetting or hydro-flushing of the backfill shall not be permitted. Care shall be taken to ensure that the utility is properly bedded with material of an approved density or in conformance with these Standard Specifications. The initial 12" of backfill above the top of the pipe shall be carefully placed to protect the pipe bedding from further backfilling operations.

Backfill shall be mechanically compacted to a minimum density of 96% of the maximum dry density of the material as determined by AASHTO Method T-99. The moisture content of the soils shall be between 2% below and 4% above the optimum moisture content as determined by the above test.

When the moisture content of the material is too low to obtain specified density, sufficient water shall be added to the material and/or lift thickness shall be decreased before compaction.

After backfilling, the Work area shall be kept maintained in a smooth and well drained condition.

E. BASIS OF PAYMENT

No measurement or direct payment will be made for any backfilling or compaction required as a part of this Work. The costs of backfilling and compaction will be considered subsidiary to other items for which direct payment is made. When directed by the City's Project Manager, additional water shall be mixed in with backfill materials to allow compaction to be completed. Such water quantities shall be paid as an "EXTRA WORK" item. Lincoln Water System hydrant meter readings immediately before/after the addition of water shall establish the volume of water used.

F. MAINTENANCE AND PROTECTION OF EXCAVATIONS

Temporary support, adequate protection and maintenance of all underground and surface utilities, structures, drains, sewers, and other obstructions encountered in the progress of the Work shall be furnished by the Contractor at Contractor's own expense. Contractor shall take all reasonable precautions to prevent movement of the sides of such excavations. The Contractor shall protect all excavations from surface water by the construction of adequate dikes. The Contractor shall furnish and put in place such sheeting and bracing as may be required to support the sides of the excavations and the Contractor shall remove such sheeting and bracing as the trenches or excavations are filled. The City's Project Manager may order the sheeting be left in place if, in the City's Project Manager's opinion, the utility or structure might be damaged by its being removed.

In lieu of sheeting and bracing, the Contractor may use a trench box of adequate design during the construction of the utility to protect the utility and all personnel.

The Contractor shall satisfy the City's Project Manager that the proposed methods of bedding and foundation material placement is in compliance with the requirements of the Standard Drawings for pipe bedding details when the trench box is moved. The Contractor shall protect the integrity of the pipe embedment zone when utilizing or moving the trench box.

20.02 EARTHWORK (Continued)

F. MAINTENANCE AND PROTECTION OF EXCAVATIONS (Continued)

No measurement or direct payment shall be made for maintenance and protection of excavations, except for sheeting left in place as required above. Payment for sheeting left in place shall be made as an “EXTRA WORK” item. Such payment shall be the value of the sheeting minus the cost of removal. The cost of maintaining and protecting excavations shall be considered subsidiary to the other items for which direct payment is made.

G. DISPOSAL OF SURPLUS MATERIAL

The Contractor shall dispose of all surplus excavated material not needed for fills or other designated purposes. All material deemed unsuitable by the City’s Project Manager shall be disposed of properly and replaced with approved material.

No measurement or direct payment shall be made for disposal or stock piling surplus materials. The costs of disposal or stock piling surplus materials shall be considered subsidiary to the other items for which direct payment is made.

All material deemed unsuitable by the City’s Project Manager and required to be removed from the job site, as well as approved replacement material not readily available at the job site, shall be measured and paid for as an “EXTRA WORK” item.

H. SOIL EROSION CONTROL

Soil Erosion Control shall be accomplished as provided in Chapter 32 of these Standard Specifications.

20.03 UTILITY ALIGNMENT AND GRADE

Prior to excavation, investigation shall be made to the extent necessary to determine the location of underground structures and utilities. Care shall be exercised by the Contractor during excavation to avoid damage to existing structures or utilities. Where shown on the plans, or as requested by the City’s Project Manager, the Contractor shall make such excavation as may be necessary to ascertain the vertical and horizontal location of existing utilities.

The utilities and structures shall be constructed and maintained to the lines and grades established by the plans and Standard Specifications. When crossing existing utilities or other structures, alignment and grade may be adjusted by the City’s Project Manager to provide clearance as required or deemed necessary to maintain minimum clearance, or to prevent future damage or contamination of either utilities or structures.

20.04 GROUND WATER

The Contractor is required to follow proper dewatering (e.g. includes sediment bags or use of sediment basins) to avoid eroding the soil on the construction site. Best management practices must be followed when water is being pumped to lakes, wetlands or directly to storm sewer inlets. When selecting discharge areas from a dewatering process, the Contractor shall not permit the water to be pumped directly into slopes, if available, dewatering activities should be directed to a vegetated area such as a well-established grassed area.

The Contractor shall discontinue dewatering if the area being discharged to shows signs of instability or erosion. If utilizing channels, the Contractor must ensure they are stable and protected with grass or vegetation. The Contractor shall avoid dewatering during heavy rain conditions. The Contractor shall never discharge water that has been contaminated with oil, grease, or chemical products, as these would need to be collected and disposed of properly and legally.

The Contractor shall provide and maintain adequate equipment to remove and dispose of ground water entering the excavations, trenches, or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below ground water shall be dewatered by lowering and keeping the ground water below the bottom of the pipe or as required to maintain a stable foundation.

The Contractor will be held responsible for the condition of any existing storm sewer system which may be used for drainage purposes on this contract, and all storm sewers shall be left clean and free of sediment. The Contractor shall not pump or drain any ground water or surface runoff into any part of the sanitary sewer system.

No measurement or direct payment shall be made for removal and disposal of ground water unless otherwise provided in the proposal or Special Provisions. The costs of removal and disposal of ground water shall be considered subsidiary to the other items of Work for which direct payment is made.

20.05 FOUNDATION AND BEDDING

A. GENERAL

Foundation and bedding materials shall meet the requirements of these Standard Specifications.

Foundation materials generally will be required where unstable soil conditions exist at the bottom of the trench. Foundation material shall be placed to the satisfaction of the City's Project Manager.

Bedding material shall be placed and compacted as called for on the plans. After the pipe has been properly placed to grade and line on the initial bedding course, additional bedding material shall be placed in 6" lifts and thoroughly settled by mechanical compaction in order to fill all voids below, around and above the top of the pipe as shown on the Standard Plans details for pipe bedding.

B. BASIS OF PAYMENT

Foundation material when placed in conformance with these Standard Specifications as directed by the City's Project Manager shall be paid as an "EXTRA WORK" item. Weight tickets for material installed shall be submitted prior to any payment for this "EXTRA WORK" item. This "EXTRA WORK" payment shall be full compensation for furnishing all materials, installation, labor, equipment, tools and incidentals necessary to create a stable foundation.

No measurement or direct payment shall be made for bedding material, except that all weight tickets for bedding material shall be submitted prior to any payment for pipe being installed. The cost of bedding materials, in the appropriate classes for the type of pipe material utilized, as shown on the drawings or for the structures constructed, shall be considered subsidiary to the other items of Work for which direct payment is made.

20.06 HORIZONTAL DIRECTIONAL DRILLING

A. GENERAL

Horizontal directional drilling (HDD) is a trenchless excavation method which is accomplished in three phases. The first phase consists of drilling a small diameter pilot hole along a designed directional path. The second phase consists of enlarging the pilot hole to a diameter suitable for installation of the pipe. The third phase consists of pulling the pipe into the enlarged hole. The Contractor shall furnish all labor, materials, tools, equipment, drilling fluids, and other items as necessary for a complete and functional installation as required, to the lines and grades shown on the Plans and as specified.

B. SUBMITTALS

1. Shop drawings, catalog data, and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe, fittings and drilling fluids. Include manufacturer's recommendation for handling, storage, and repair of pipe and fittings damaged.
2. The proposed phasing and schedule of the Work including location of launching and receiving pits, services affected, length of pipe effected during each phase, and proposed traffic disruptions. The phasing and schedule of the Work must be approved by the City's Project Manager prior to Work starting.
3. The proposed methods for monitoring, prevention, containment, and clean-up of drilling fluid surface returns at unauthorized locations.
4. The tabulation of pilot hole survey coordinates.
5. Written record of the installation pullback loads on the utility during the installation process.
6. Plan and profile drawings of the documented as-built location of the installed utility.

20.06 HORIZONTAL DIRECTIONAL DRILLING (Continued)

C. MATERIALS

1. Water main installed by HDD shall use Certa-Lok C900 RJ, Class 200 DR 14 pipe as manufactured by Certainteed, or approved equal. Pipe material other than Certa-Lok must be approved prior to ordering. Restrained joint pipe shall also meet all performance requirements of AWWA C900.
2. The Contractor shall at all times provide and maintain instrumentation which will accurately locate the pilot hole, measure drill string axial and torsional loads, and measure drilling fluid discharge rate and pressure. The City's Project Manager shall have access to these instruments and their readings at all times. A log of all recorded readings shall be maintained by the Contractor and will become a part of the Project Record Documents supplied by Contractor. Instrumentation systems shall be calibrated immediately prior to beginning the work.
3. The Drilling Fluid System shall be capable of mixing and delivering the drilling fluid to the drill head or the reamer in the volumes and pressures required. Contractor shall maximize recirculation of drilling fluid surface returns. Contractor shall provide solids control and fluid cleaning equipment of a configuration and capacity that can process surface returns and produce drilling fluid suitable for reuse.
4. The Drilling Fluid shall be used as required during the installation of the pilot hole, enlarging of the pilot hole, and installation of the water pipe. No drilling fluid will be accepted or utilized that does not comply with permit requirements and environmental regulations.
5. Drill Pipe (drill stem) shall be of sufficient size and strength to resist all installation loadings including tensile, compressive, bending, and torsional loads. An appropriate safety factor shall be used by the Contractor in sizing the drill pipe.
6. Drill Head configuration shall be as selected by Contractor and compatible with requirements for location system.
7. Reamer and Swivels shall be as selected by Contractor. Reamer and swivel assembly shall be capable of enlarging borehole while preventing damage due to rotation of the pipe during its pullback into its final position.

20.06 HORIZONTAL DIRECTIONAL DRILLING (Continued)

D. INSTALLATION

1. BORING OF THE PILOT HOLE

Install pilot hole using steerable drilling head. Pilot hole shall be drilled along the path shown on the Drawings to the tolerances listed herein. Listing of tolerances shall not relieve Contractor from responsibility for safe operations or damage to adjacent utilities and structures.

Monitor location of drill head as required to install pilot hole to indicated lines and grades, but in no instance shall the interval between locating the drilling head exceed 15' in length along the alignment.

Use drilling fluids as required to lubricate and support the pilot hole excavation.

Pilot hole shall be free from abrupt changes in line or grade that could result in unacceptably high loadings on the drill pipe or the water pipe during installation.

After completion of pilot hole drilling, Contractor shall provide a tabulation of coordinates, referenced to the drilled entry point, which accurately describe the location of the pilot hole. This tabulation shall be in addition to the log of recorded readings required.

2. PRE-REAMING OF THE PILOT HOLE

Subsequent to the City's Project Manager's acceptance of pilot hole, Contractor may, at his option, pre-ream the pilot hole as necessary for installation of the water pipe.

Pre-reaming operations shall be conducted at the discretion of the Contractor. Contractor shall insure that a hole sufficient to accommodate the pull section of water pipe has been produced. Any damage to the water pipe resulting from inadequate pre-reaming shall be the responsibility of the Contractor. All provisions of this Specification relating to simultaneous reaming and pulling back operations shall also pertain to pre-reaming operations.

Use drilling fluids as required to lubricate and to support the reamed pilot hole.

Use of pre-reaming shall be at the option of the Contractor; however, lack of pre-reaming shall not result in excessive installation loads on the water pipe.

3. REAMING AND PULLBACK OF THE MAIN

Contractor shall utilize a reamer to enlarge the pilot hole to sufficient size for installation of the main without imposing excessive installation loadings on the water pipe.

Grippers used on the water pipe shall not damage adjacent sections of the pipe. Sections of the pipe utilized by the grippers shall be removed from the pipe after installation.

Contractor shall handle and support the pull section of water pipe so as to prevent damage and minimize pullback forces. Pull section of water pipe shall be supported as it proceeds during pull back so that it moves freely and the pipe is not damaged.

20.06 HORIZONTAL DIRECTIONAL DRILLING (Continued)

D. INSTALLATION (Continued)

Contractor shall use drilling fluids as required to lubricate and support the reamed pilot hole, lubricate installation of the water pipe, and completely fill all overcut of the reamed pilot hole.

The pull section of water pipe shall be installed in the reamed hole in such a manner that external pressures are minimized and an appropriate counter-balancing internal pressure is maintained. Any damage to the pipe resulting from external pressure during installation shall be the responsibility of Contractor. The pipe shall be filled with water as it enters the ground to ensure that adequate internal pressure is maintained at all points to counter balance external collapse pressures. Contractor shall submit pipe filling procedure proposed for use to the City's Project Manager for review and acceptance.

Contractor shall continuously monitor the pulling loads imposed upon the water pipe. The maximum allowable tensile load imposed on the water pipe shall not exceed the recommendations of the pipe manufacturer. Contractor shall take all required measures necessary to prevent installation loads on the water pipe from exceeding those recommended by the pipe manufacturer. If necessary, Contractor shall at his own expense, stop the pullback of the water pipe, remove the section of pipe installed within the enlarged pilot hole, and pre-ream the pilot hole as required to allow installation of the water pipe without exceeding the allowable pullback forces.

After the installation, Contractor shall determine and log the installed location and depth of the water pipe. Contractor shall submit to the City's Project Manager a drawing detailing the installed location of the water pipe in both plan and profile view.

E. REJECTION

1. If the pilot hole is rejected by the City's Project Manager, the Contractor shall, at his own expense, backfill the rejected pilot hole with bentonite, and install a pilot hole acceptable to the City's Project Manager.
2. Monitoring records indicate that pullback loads exerted on pipe exceeded the loadings recommended by pipe manufacturer.
3. Installation outside of the allowable tolerances.

F. TOLERANCES

Tolerances for the pilot hole and the installed water pipe shall be as listed below.

1. For vertical tolerance, the water pipe shall be installed at the grade indicated on the plans. Minor deviations from the grade indicated on the plans may be allowed, provided that:
 - a. The soil cover above the top of the water pipe shall not be less than shown on the drawings.
 - b. Except at crossings under water courses, the water pipe shall maintain downward slope towards all blowoff points to provide for positive drainage of the water pipe.
 - c. The water pipe shall maintain upward slope towards all venting points to provide for positive venting and air release from the water pipe.

20.06 HORIZONTAL DIRECTIONAL DRILLING (Continued)

F. TOLERANCES (Continued)

2. For horizontal tolerance, the water pipe shall be installed at the locations indicated on the plans. Minor deviations from the locations indicated on the plans may be allowed, provided that:
 - a. The horizontal deviation of the water pipe from the location required on the drawings shall not exceed one (1) foot at any location along the water pipe without prior authorization of the City's Project Manager.
 - b. The horizontal deviation shall not cause the water pipe to interfere with existing structures, utilities, or result in any part of the finished work being installed outside of the permanent easements.

G. CLEAN UP AND DISPOSAL OF MATERIALS

1. Contractor shall remove all construction debris and spoil material and dispose of it at an acceptable location.
2. Drilling fluid shall be removed from pits and then the pits backfilled as required.
3. Disposal of excess drilling fluids shall be the responsibility of the Contractor and shall be conducted in compliance with all environmental regulations, right-of-way and workspace agreements, and permit requirements. Disposal of drilling fluids shall not be allowed on the project site.
4. Contractor shall employ his best efforts to maintain full annular circulation of drilling fluids. Drilling fluid returns at location other than the entry and exit points shall be minimized. In the event that annular circulation is lost, Contractor shall take steps to restore circulation. If inadvertent surface returns of drilling fluids occur, they shall be immediately contained as required and collected. If the amount of the surface return is not great enough to allow practical collection, the affected area shall be diluted with fresh water and the fluid will be allowed to dry and dissipate naturally. If the amount of the surface return exceeds that which can be contained and collected using practical methods, drilling operations shall be suspended until surface return volumes can be brought under control.

H. BASIS OF PAYMENT

Directional Drilling for carrier pipes completed in conformance with these Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for **DIRECTIONAL DRILLING FOR ___" WATER MAIN**, for each size and type called for in the Contract Documents. Such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to produce the directional drill and install the carrier pipe as required in the Contract Documents.

20.07 CONCRETE AND REINFORCING STEEL FOR STORM DRAINAGE

A. GENERAL

When called for on the plans, the Contractor shall construct reinforced concrete collars, elbows, plugs and headwalls for storm drainage at the locations indicated. The collars, elbows, plugs and headwalls shall conform to the details shown in the Lincoln Standard Plans.

B. BASIS OF PAYMENT

When called for in the proposal, concrete for storm water collars, elbows, plugs and headwalls placed in conformance to these Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per cubic yard for **CONCRETE FOR COLLARS, ELBOWS, PLUGS AND HEADWALLS, IN PLACE**. The concrete shall not be measured separately for payment, but the quantities shall be established based upon the volume of concrete required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all mixing, hauling, forming, placing, jointing, curing, finishing, excavation, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the structure.

When called for in the proposal, payment for reinforcing steel for collars, elbows, plugs and headwalls placed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be made at the contract unit price bid per pound for **REINFORCING STEEL FOR COLLARS, ELBOWS, PLUGS AND HEADWALLS, IN PLACE**. The reinforcing steel shall not be measured separately for payment, but the quantities shall be established based upon weight of steel required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all placing, tying, chairs, materials, equipment, tools, labor, and incidentals necessary to place the steel in the proper locations in conformance with the plans.

20.08 CONCRETE AND REINFORCING STEEL FOR SANITARY SEWER

A. GENERAL

When called for on the plans, the Contractor shall construct reinforced concrete plugs and collars for sanitary sewer at the locations indicated. The plugs and collars shall conform to the details shown in the Lincoln Standard Plans.

B. BASIS OF PAYMENT

When called for in the proposal, concrete for sanitary sewer plugs and collars placed in conformance to these Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per cubic yard for **CONCRETE FOR PLUGS AND COLLARS, IN PLACE**. The concrete shall not be measured separately for payment, but the quantities shall be established based upon the volume of concrete required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all mixing, hauling, forming, placing, jointing, curing, finishing, excavation, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the structure.

20.08 CONCRETE AND REINFORCING STEEL FOR SANITARY SEWER (Continued)

B. BASIS OF PAYMENT (Continued)

When called for in the proposal, payment for reinforcing steel for sanitary sewer plugs and collars placed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be made at the contract unit price bid per pound for REINFORCING STEEL FOR PLUGS AND COLLARS, IN PLACE. The reinforcing steel shall not be measured separately for payment, but the quantities shall be established based upon weight of steel required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all placing, tying, chairs, materials, equipment, tools, labor, and incidentals necessary to place the steel in the proper locations in conformance with the plans.

20.09 CONCRETE AND REINFORCING STEEL FOR WATER MAIN

A. GENERAL

When called for on the plans, the Contractor shall construct reinforced concrete thrust collars, thrust blocks, anchorages, gravity blocks, tee blocks and plug blocks for water main at the locations indicated. The thrust blocks, anchorages, tee blocks and plug blocks shall conform to the details shown in the Lincoln Standard Plans.

Concrete shall be L3500 conforming to Chapter 3 of these Standard Specifications. Reinforcing steel shall conform to "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement" ASTM Designation A615, Grade 40 or 60, or "Standard Specification Axle-Steel Deformed and Plain Bars for Concrete Reinforcement" ASTM Designation A617, Grade 60.

B. BASIS OF PAYMENT

When called for in the proposal, concrete for water main thrust collars, thrust blocks, anchorages, gravity blocks, tee blocks and plug blocks placed in conformance to these Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per cubic yard for CONCRETE FOR COLLARS, BLOCKS AND ANCHORAGES, IN PLACE. The concrete shall not be measured separately for payment, but the quantities shall be established based upon the volume of concrete required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all mixing, hauling, forming, placing, jointing, curing, finishing, excavation, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the structure.

When called for in the proposal, payment for reinforcing steel for water main thrust collars, thrust blocks, anchorages, gravity blocks, tee blocks and plug blocks placed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be made at the contract unit price bid per pound for REINFORCING STEEL FOR COLLARS, BLOCKS AND ANCHORAGES, IN PLACE. The reinforcing steel shall not be measured separately for payment, but the quantities shall be established based upon weight of steel required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all placing, tying, chairs, materials, equipment, tools, labor, and incidentals necessary to place the steel in the proper locations in conformance with the plans.

20.10 PAVEMENT CONSTRUCTION AND RECONSTRUCTION

Pavement reconstruction and miscellaneous masonry reconstruction shall be accomplished in conformance as described in these Standard Specifications.

20.11 FINAL CLEANUP

A. GRAVEL OR ROCK ROADWAY SURFACE

Where the Work of the Contract crosses or is parallel to any unpaved roadway and where the roadway surface is affected in any way by operations under the contract, the Contractor shall repair and restore the same to at least its original condition. Such restoration shall include, but not be limited to, regrading ditches and roadway surface, restoration of culverts and drives, and placement of rock or gravel surfacing as directed by the City's Project Manager.

The cost of regrading ditches, roadway surfaces, and drives shall not be paid for directly but shall be considered subsidiary to other items of Work for which direct payment is made.

Culverts required to be removed and re-laid shall be measured and paid for as provided in Chapter 21 of these Standard Specifications. Crushed rock or gravel surfacing shall be measured and paid for as provided in Chapter 9 of these Standard Specifications.

B. FINAL CLEANUP AND PARKING SPACE FINISH

When all other Work has been completed, the Contractor shall thoroughly clean all pavement, parking spaces, sidewalks, rights-of-way, storage areas, access roads, and private property of all earth and other debris by use of approved equipment. All pavement, parking spaces, sod, sidewalks, storage areas, access roads and private property shall be restored to a condition at least equal to that existing prior to any operations under this Contract.

No measure or direct payment shall be made for cleanup or parking space finish. The costs of cleanup and parking space finish shall be considered subsidiary to other items for which direct payment is made.

C. SODDING AND SEEDING

Sodding and seeding shall be accomplished as provided in Chapter 30 of these Standard Specifications.

20.12 COLD WEATHER CONSTRUCTION

A. LIMITS OF CONSTRUCTION

Work to be performed in developed areas, or Work affecting the operation, capacity, and safety of arterial and collector streets, between December 1 and March 15, shall be limited by the following provisions:

1. A maximum of 650 linear feet within the limits of the project may be under construction at one time.
2. A maximum of 2 intersections may be closed at one time within project limits, even though the third intersection may not violate the 650' limit described in Paragraph 1 above.
3. "Under Construction" shall include all operations which disrupt or limit the use of public facilities, such as pavement removal, sidewalk removal, excavation, backfilling, pipe laying, material storage, equipment storage, and/or any other operation deemed by the City's Project Manager as a disruption of normal ingress and egress to the public right-of-way within project limits.

20.12 COLD WEATHER CONSTRUCTION (Continued)

A. LIMITS OF CONSTRUCTION (Continued)

4. Temporary restoration will be required to reduce long-term disruptions and inconvenience during construction. 2 weeks after beginning Work in an area, the City's Project Manager shall require temporary restoration of facilities by the Contractor. The entire cost of installation, maintenance, and removal of such temporary installations shall be the Contractor's responsibility.

B. SUSPENSION OF WORK

Suspension of Work during the winter construction period, December 1 to March 15, may be requested by the Contractor under the following conditions:

1. The request must be made in writing to the City's Project Manager and shall include the beginning date and duration. If Work is to be resumed prior to expiration of time requested, 48 hours written notice of such intent will be required.
2. The Contractor shall be required to restore all vehicular and pedestrian facilities to full use by either permanent or temporary restoration before the suspension period will become effective.
3. Calendar days included in the period that Work is actually suspended shall be counted from the effective suspension date, and the governing completion date shall be adjusted accordingly.

In no case shall a granted suspension of Work be cause for requesting or granting additional calendar days for completion of this Contract.

The City's Project Manager shall state to the Contractor, in writing, the effective suspension date and the date on which the suspension expires.

In addition, following the suspension period, the City's Project Manager shall notify the Contractor, in writing, of the new completion date of the Contract as provided above.

20.13 SUBSTANTIAL COMPLETION

Refer to Chapters 21 through 23 for a specific definition of Substantial Completion for each type of utility Work.

20.14 FINAL ACCEPTANCE

Refer to Chapters 21 through 23 for a specific definition of Final Acceptance for each type of utility Work.

20.15 GUARANTEE

Refer to Chapters 21 through 23 for a specific definition of guarantee for each type of utility Work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

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CHAPTER 21

STORM DRAINAGE SYSTEMS

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CHAPTER 21

STORM DRAINAGE SYSTEMS

21.00 GENERAL

The Work covered in this chapter shall include the laying and jointing of storm drain pipe, concrete box construction, concrete channel liners, and construction of storm drain appurtenances.

21.01 MATERIALS

A. CONCRETE

Concrete used in storm drain construction and reconstruction shall conform to the requirements of Chapter 3 of these Standard Specifications.

B. REINFORCED CONCRETE PIPE

1. Reinforced concrete pipe shall be circular in cross section, unless otherwise indicated, with tongue and groove joints, and shall be manufactured in conformance with the requirements of “Standard Specifications for Reinforced Concrete Culvert Pipe, Storm Drain and Sewer Pipe”, ASTM Designation C 76 for Class III Pipe with Wall B, unless otherwise specified on the plans or in the Special Provisions.
2. When so indicated on the plans, reinforced concrete elliptical pipe shall be supplied and shall be manufactured in conformance with the requirements of “Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe”, ASTM Designation C 507.

C. RUBBER GASKET

Rubber gaskets shall be from extruded closed cell rubber.

1. The base polymer shall be a blend of neoprene and EPDM meeting the physical requirements of “Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber”, ASTM D 1056, Class 2C2.
2. The closed cell rubber shall meet the ozone testing requirement of “Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)”, ASTM D 1171, of 70 hours at a 40° C at 100 PHM, bent loop with no cracks.
3. Each seal shall be completely covered with a natural skin and shall be assembled into a continuous ring which shall conform to the joint size and shape.
4. Cross sectional dimensions shall conform to RMA Class II tolerances and installation shall be in conformance with the manufacturer’s recommendations.

21.01 MATERIALS (Continued)

D. IRON CASTINGS

All iron castings shall meet the requirements of “Standard Specification for Gray Iron Castings”, ASTM Designation A 48, Class 30. They shall conform in all respects to the designs for such castings as shown on the Standard Plans. All frames and covers shall be machined so that each cover will fit properly in its frame with no rocking. No casting will be accepted that is warped, cracked, has swells, or that has been plugged or filled.

E. CONCRETE REINFORCEMENT

1. **REINFORCEMENT BARS:** All reinforcement bars shall meet the requirements of “Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement”, ASTM Designation A 615, Grade 40 or Grade 60. Bars shall be free from excess rust, scale, or other substances which prevent the bonding of the concrete to the reinforcement.
2. **REINFORCEMENT BAR SUPPORTS:** Reinforcement bar supports shall be of a satisfactory design and of sufficient strength to hold the metal reinforcement in place while the concrete is being placed.

F. BRICK

All brick shall be clean, hard burned brick having true shape and sharp edges for their whole length. Unless otherwise specified, all brick shall be new brick. Broken brick shall be used only to close joints and no bats smaller than half a brick shall be used. In addition to the foregoing, all brick shall meet all the requirements of “Standard Specification for Sewer and Manhole Brick Made From Clay or Shale”, ASTM Designation C 32; all drain brick shall be Grade SS and all manhole brick shall be Grade MS. Concrete brick conforming to “Standard Specification for Concrete Brick”, ASTM Designation C 55, Grade N 1, may be used in lieu of the clay or shale brick specified above.

G. MORTAR

Mortar used in the construction of manholes or other appurtenant structures shall be Type S as specified in “Standard Specification for Mortar for Unit Masonry”, ASTM Designation C 270. Proportions of the mixture shall conform to either of the two following alternatives:

<u>Alternate</u>	<u>Portland Cement</u>	<u>Masonry Cement</u>	<u>Hydrated Lime or Lime Putty</u>	<u>Aggregate Loose & Damp</u>
1	1/2	1	0	Not less than 2 1/4 nor more than
2	1	0	1/4-1/2	than 3 times the sum of the volume of the cements and lime used

H. PRECAST MANHOLE SECTIONS

Precast manhole sections shall be manufactured in conformance with the requirements of “Standard Specification for Precast Reinforced Concrete Manhole Sections”, ASTM Designation C 478.

21.01 MATERIALS (Continued)

I. PRECAST BOX CULVERTS

When so indicated on the plans, precast box culverts shall be supplied and shall be manufactured in conformance with the requirements of "Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers", ASTM Designation C 1433.

J. WIRE GABION

GABION shall be supplied as specified, in various lengths and heights. The lengths shall be multiples of the horizontal width. The heights shall be fractions of the horizontal width. The horizontal width shall not be less than 3'. However, all gabion furnished by a manufacturer shall be of uniform width. Dimensions for heights, lengths and widths are subject to a tolerance limit of $\pm 5\%$ of manufacturer's stated sizes.

GABION shall be fabricated in such a manner that the sides, ends, lid, and diaphragms can be assembled at the construction site into a rectangular basket of the specified sizes. GABION shall be of single unit construction. The base, lid, ends, and sides shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.

Where the length of the gabion exceeds its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gauge as the body of the gabion into cells whose length does not exceed the horizontal width. The gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that no additional tying at this juncture will be necessary.

GABION shall be made of hexagonal triple twist mesh $3 \frac{1}{4}" \times 4 \frac{1}{2}"$. The wire mesh shall be made of galvanized steel wire having a diameter of $0.1181" \pm 2.5\%$. The tensile strength of the wire shall be in the range of 60,000 to 85,000 p.s.i. The minimum zinc coating of the wire shall be 0.80 ounces per square foot of uncoated wire surface in conformance with Federal Specification QQ-W-461g, Class 3.

All perimeter edges of the mesh forming the gabion shall be securely salvaged so that the joints formed by tying the selvages have at least the same strength as the body of the mesh.

Tie wire or connecting wire shall be supplied in sufficient quantity for securely fastening all edges of the gabion and diaphragms. The tie wire shall meet the same Standard Specifications as the wire used in the mesh, except that it shall have a diameter of $0.0866" \pm 2.5\%$. Tie wire and connecting wire used for assembling or connecting to PVC coated gabion shall be PVC coated wire provided by the gabion manufacturer for that purpose.

The wire mesh for PVC coated baskets shall be made of galvanized steel wire and shall conform to all Standard Specifications for galvanized baskets except that the mesh wire exclusive of PVC coating may be 0.0118" smaller in diameter.

The PVC coating shall be a minimum of four-tenths millimeter in thickness. The PVC coating shall be applied prior to weaving of the baskets.

The PVC protective coating shall be resistant to the air and sea water and shall comply with the following test requirements:

21.01 MATERIALS (Continued)

J. WIRE GABION (Continued)

1. Immersion of the wire for 20 hours in Hydrochloric acid (solution composed 50% H₂O and 50% HCL concentration 21 Baume-Test temperature 15° C or immersion for 60 hours in a saturated solution of salt water at 15° C without noticeable loss of weight due to corrosion of the coating material and without reduction of the wire's diameter.
2. After immersion of a length of the coated wire in a 3.5% solution of Potassium Permanganate (KMnO₄) for a continuous period of 50 at an ambient temperature, the maximum penetration between the coating and the core wire from a square cut end shall be 0.472".
3. The protective coating shall not be altered or deformed by temperatures ranging between 150.0°F and -40°F.

K. GABION STONE

The stone used to fill the gabion shall be from sources approved by the City's Project Manager. The size of the stone shall be such that not more than 5% by mass shall pass the 4" sieve. The maximum weight for any one stone shall not exceed 50 pounds. The maximum length of stone shall not exceed 12". Each stone shall have one dimension that has a measurement of 4". The approved stone shall conform to the soundness requirements of "Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate", ASTM Designation C 88.

L. GROUT FILLED FABRIC

Grout shall consist of a mixture of Portland cement, fine aggregate, and water so proportioned and mixed as to provide a pumpable slurry. Pozzolan and grout fluidifier conforming to these Standard Specifications may be used at the option of the Contractor. The mix shall exhibit a compressive strength of 2000 p.s.i. at 28 days when made and tested in conformance with "Standard Practice for Making and Curing Concrete Test Specimens in the Field", ASTM C 31 and "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens", ASTM Designation C 39, or "Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in Laboratory", ASTM Designation C 942 if a grout fluidifier is used.

Grout components shall conform to the following:

1. Portland cement: Federal Specifications SS-C 192 or "Specification for Portland Cement", ASTM Designation C 150.
2. Pozzolan, if used: "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete", ASTM Designation C 618/C 618 M.
3. Water shall be fresh, clean, and free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter.
4. Aggregate: "Standard Specification for Concrete Aggregates", ASTM Designation C 33, except as to grading. Aggregate grading shall be reasonably consistent and shall be well graded from the maximum size which can be conveniently handled with available pumping equipment.

21.01 MATERIALS (Continued)

L. GROUT FILLED FABRIC (Continued)

5. Grout fluidifier, if used: "Standard Specification for Grout Fluidifier for PrePlaced-Aggregate Concrete", ASTM C 937.

The average compressive strength of the grout-filled fabric test cylinders shall be at least 20% higher at seven days than that of companion test cylinders made in conformance with "Standard Practice for Making and Curing Concrete Test Specimens in the Field", ASTM Designation C 31, or "Standard Test Method for Compressive Strength of Grouts for Preplaced Aggregate Concrete in the Laboratory", ASTM Designation C 942 if grout fluidifier is used, and not less than 2500 p.s.i. at 28 days.

Fabric forming material shall be "Fabriform" or approved equal.

Fabric forming material shall consist of specially-woven multiple panels of double-layer, open-selvage fabric joined in a mat configuration. The two fabric layers shall each be no lighter than 18 x 18 count per inch, 1000 denier nylon or 1000 denier polyester tire cord, of which at least 50% by weight shall be producer-bulked continuous multi filament tire cord nylon. Fabric of equal or greater strength and porosity may be used with the approval of the City's Project Manager. Fabric containing film type polypropylene fiber shall not be considered as an acceptable alternate by reason of its low strength, low bond to mortar and extreme sensitivity to ultraviolet degradation.

1. Filter Point fabric (designated as FP on drawings) shall consist of multiple panels of double layer fabric joined together in such a manner as to provide Filter Points on spaced centers for the relief of hydrostatic uplift pressure. Filter Points shall be woven in such a manner as to permit passage of ground water through the Filter Points. Filter Points shall be on approximately 5" or 8" or 10" centers as woven and as indicated on drawings.
2. Uniform Cross Section Fabric (designated as UCS on drawings) shall consist of multiple panels of double layer fabric joined together by interwoven ties of a uniform length spaced no further apart than 3" centers. Hydrostatic uplift relief, where required, shall be provided by sewing together the two fabric layers at locations and in the manner indicated on the drawings or by inserting plastic tubes through the mat on specified centers. Filter cloth shall be placed beneath the mat if plastic or other type tubes are used to prevent passage of fines through the tubes. These tubes shall be installed in such a manner as to ensure that no damage to filter cloth occurs.
3. Individual mill width panels shall be cut to suitable length and the two layers of fabric separately joined edge to edge by means of nylon thread. The tensile strength of stitched joints shall be not less than 100 pounds per inch.
4. Fabric porosity is essential for the successful execution of this Work. At the direction of the City's Project Manager, the Contractor shall demonstrate the suitability of fabric design by injecting the proposed grout into 6" diameter sleeves under a pressure of 10 to 15 p.s.i. which shall be maintained by means of air pressure or a standpipe for 10 minutes. The sleeves shall be constructed of the same fabric used in the individual layers of fabric. 6" x 12" test cylinders shall be cut from each specimen and tested in conformance with "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens", ASTM Designation C 39.

21.01 MATERIALS (Continued)

M. GEOTEXTILE FILTER FABRIC

Geotextile filter fabric shall be of nonwoven needle punched construction and consist of continuous long chain polymeric fibers composed of polyester polypropylene, polyethylene, or polyamide. The fibers shall be oriented into a multi-directional stable network which retains their positions relative to each other and allows the passage of water as specified. The fabric shall be free of any chemical treatment or coating which reduces permeability. The fabric shall be puncture and tear resistant; mildew, rodent, insect, and rot resistant; freeze and thaw stable; and shall be inert to chemicals commonly found in acid or alkaline soils. The fabric shall be resistant to deterioration due to ultraviolet light and/or heat exposure. The geotextile shall conform to typical physical properties, as shown below:

<u>Physical Property</u>	<u>Test Procedure</u>	<u>Minimum Test Results</u>
Tensile Strength, wet, lbs.	ASTM D 1682	175 (80)
Elongation, wet, %	ASTM D 1682	65
Coefficient of Water Permeability, cm/sec.	Constant head	0.10
Puncture Strength, lbs.	ASTM D 751*	90
Mullen Burst Strength, psi	ASTM D 3786	335
Abrasion Resistance, lbs.	ASTM D 3884	55 (min.)
	Taber Test	
	(1000 revolutions, 1 kg. load/wheel)	
Pore Size – EOS	Corps of Engineers CW-02215	70-100
Ultraviolet Resistance	ASTM D-1682	70
% Strength Retention	(After 500 Xenon Weatherometer Hours)	

*Tension testing machine with ring clamp; steel ball replaced with a 5/16" diameter solid steel cylinder with hemispherical tip centered within the ring clamp.

The fabric shall have a minimum weight of 5 ounces per square yard.

The geotextile shall be furnished in a protective wrapping which shall protect the fabric from ultraviolet radiation and from abrasion due to shipping and handling.

21.02 EXCAVATION AND BACKFILL

Excavation and backfill shall conform to the requirements of Chapter 20 of these Standard Specifications.

21.03 LAYING PIPE

A. GENERAL

For all ordinary laying conditions in firm soils, the Contractor shall lay each pipe to line and grade, taking care to provide depressions for jointing of each pipe.

All pipe shall be laid to line and grade as indicated on the plans. The laying of pipe shall begin at the lowest point in the line and proceed upgrade. Spigot ends shall be laid in the direction of flow. All pipe shall be so laid, fitted, and matched as to form a drain with a smooth, uniform, and continuous interior surface throughout.

After each pipe has been laid and firmly bedded in place, the entire joint space and lift hole shall be completely filled with mortar composed of 1-part Portland Cement and 2 parts of clean sand by volume. If the pipes are of 36" in diameter or larger, the joint space shall also be filled on the inside surface of the pipe. The mortar shall be cured and protected as directed by the City's Project Manager.

In lieu of the mortar joint specified above, joints may be made of approved rubber gaskets or cold mix asphalt jointing compound. The methods of making the joints and filling of lift holes shall be approved by the City's Project Manager.

The open end of the pipes shall be protected at all times against the entrance of earth or other foreign material.

Tight bulkheads shall be placed in all open ends when pipe laying is stopped. The ditch or swale shall be graded as necessary to permit the proper entrance of surface runoff into or out of the system.

When called for on the plans, the Contractor shall remove and relay reinforced concrete storm drain pipes to the lines and grades indicated. The Contractor shall exercise care in the removal so as not to damage the existing pipe or the pipe removed. Where pipes are unavoidably damaged, the Contractor shall replace the damaged pipe with new material and be compensated as provided below. Where, in the opinion of the City's Project Manager, pipes are damaged due to neglect of the Contractor, the pipe shall be removed and replaced with new materials at the Contractor's cost.

When the plans or Contract Documents call for removal and salvage of storm drain pipes, the Contractor shall remove and reuse the salvaged pipes. Where pipes are to be removed and salvaged but are, in the opinion of the City's Project Manager, damaged beyond their usefulness, the Contractor shall be compensated for removal only and separately be compensated for new. When the plans or Contract Documents call for removal of storm drain pipes, the Contractor shall remove and dispose of the pipes off the job site.

21.03 LAYING PIPE (Continued)

B. BASIS OF PAYMENT

Reinforced concrete storm drain pipe removed, removed and re-laid, or removed and salvaged in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per linear foot for REMOVE STORM DRAIN PIPE, __"; REMOVE AND RELAY RCP STORM DRAIN, ____"; REMOVE AND SALVAGE RCP STORM DRAIN, ____". Such payment shall be full compensation for all excavation, removal, bedding if required, relaying, loading salvaged pipe, backfill disposal, materials, equipment, tools, labor, and incidentals necessary to perform the Work called for as per plan.

Reinforced Concrete Pipe (RCP) storm drain pipe, elliptical Reinforced Concrete Pipe (RCP), and precast reinforced concrete (RC) box storm drains, constructed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured from inside face of structure to inside face of structure, or to the end of the pipe or precast box for each size of pipe or precast box.

Payment for pipes and precast boxes shall be made at the contract unit price bid per linear foot for RCP STORM DRAIN, CLASS __, __"; ELLIPTICAL RCP STORM DRAIN, __" x __"; PRECAST RC BOX STORM DRAIN for the various sizes shown on the proposal. Such payment shall be full compensation for all excavation, bedding, jointing, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the items of Work called for as per plan.

Grading required as a part of storm drainage construction shall not be measured or paid for separately. The costs of such grading shall be considered as subsidiary to the costs of the items for which direct payment is made.

21.04 CURVED REINFORCED CONCRETE STORM DRAIN PIPE

Straight sections of reinforced concrete pipe may be installed on curves by opening the outside of the joints in conformance with this Standard Specification. Installation of reinforced concrete pipe on a curve will only be allowed with prior approval of the City's Project Manager or Engineer. Where reinforced concrete pipe is to be installed on radii smaller than those shown in this Standard Specification, radius or beveled pipe shall be used only with the prior approval of the City's Project Manager.

All joints that have the outside of the joint opened to form the curved alignment shall be filled with mortar or mastic. The maximum joint opening shall be not more than 1/2 of the tongue length.

No separate measurement or payment shall be made for beveled or radius pipe. The measurement and payment for beveled and radius pipe shall be included in the measurement and payment for standard storm drain pipes as provided in Chapter 21 of these Standard Specifications.

21.04 CURVED REINFORCED CONCRETE STORM DRAIN PIPE (Continued)**TABLE 21.04 A - CURVED REINFORCED CONCRETE STORM DRAIN PIPE**

Nominal Diameter inches	Tongue Length inches	Maximum Joint Opening inches	Minimum Radius in feet for Given Laying Length (LL) (using unbeveled round pipe)	
			4 ft. LL	8 ft. LL
15	3 3/8	1 5/8	50	101
18	3 3/8	1 5/8	55	110
21	3 3/8	1 5/8	63	127
24	3 3/8	1 5/8	72	144
30	3 3/8	1 5/8	89	177
36	3 7/8	1 5/8	105	211
42	3 7/8	1 7/8	106	212
48		1 7/8	121	241
54	4 7/8	2 3/8	107	215
60	4 7/8	2 3/8	119	238
72		2 3/8	142	284
84	5	2 1/2	162	325

21.05 CONNECTIONS TO EXISTING STORM DRAINS

A. GENERAL

The Contractor shall make all connections and taps of the new storm drains to existing storm drainage systems as shown on the plans. Tapping pipe should not extend more than 2" into existing pipe. Existing manhole or inlet bottoms shall, if necessary, be reconstructed in substantially the same manner as herein specified.

B. BASIS OF PAYMENT

Connections to existing storm drainage systems, constructed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per each for TAP EXISTING STORM DRAIN MANHOLE AND REPLACE INVERT; TAP EXISTING STORM DRAIN INLET AND REPLACE INVERT; TAP EXISTING RCP; or TAP EXISTING RC BOX, for each item called for in the proposal. No classification shall be made as to sizes of pipes being tapped or sizes of connecting pipes. Such payment shall be full compensation for all tapping, shaping the connecting pipes, brick, mortar, concrete, materials, equipment, tools, labor, and incidentals necessary to complete the taps and seal the resulting voids in the walls of the storm drains in conformance with the details shown on the drawings.

No direct measurement or payment shall be made for connections or taps of various parts of the Work to other parts of the Work performed under the same contract. The cost of these taps and connections shall be considered subsidiary to the other items for which direct payment is made.

21.06 REINFORCED CONCRETE BOX STORM DRAINS AND STRUCTURES

A. GENERAL

Reinforced concrete box storm drains and structures shall be complete, including box section, wing walls, apron, manholes, taps, connections, etc. Steel reinforcement shall be placed as indicated on the plans.

B. FORMS

Forms shall be true to the required shapes and sizes, properly braced, and strong and stiff enough to withstand, without springing or warping, all operations incidental to laying the mat of steel reinforcement and placing the concrete. They shall be mortar tight, and the form surfaces in contact with the concrete shall be smooth and clean. To prevent adhesion to the concrete, the contact surfaces of all forms shall be coated with soap, mineral oil, or other substances, and they shall be thoroughly wetted before the concrete is placed.

Tie wires and tie rods may be left in the concrete, providing the end portions are removed to within approximately 2" of any exposed face. All holes left after removal of the rod or wire ends shall be completely filled with cement mortar immediately after the concrete curing forms have been removed. Such mortar shall be kept moist until thoroughly bonded to the concrete. Before depositing any concrete in the forms, the City's Project Manager shall make an observation of the condition of the forms and the placing of the reinforcing steel. All imperfections in either shall be remedied before any concrete is placed.

During the process of placing the concrete in any formed section, a taut line shall be kept in place by the Contractor at the back side of the forms. Competent workers shall keep a constant check to determine any deflection of the forms. Any such deflection shall be corrected immediately.

The Contractor shall use great care in the removal of forms so as not to injure the concrete in any way, and he shall be wholly responsible for any injury due to premature removal of forms. Wall forms, normally, may be removed 12 to 24 hours after placement of the concrete. Roof forms shall remain in place until tests show that the concrete has developed a compressive strength of 3000 p.s.i. Test specimens and tests shall comply with current ASTM Standards. Test specimens shall be cured under job conditions. In the absence of such tests, roof forms shall remain in place 7 days when the average ambient temperature has been 55° F for 12 hours or more. Forms shall not be removed without permission of the City's Project Manager.

C. STEEL REINFORCEMENTS

The exact position and bar size of the reinforcements are shown on the plans. Information for purchasing, cutting and bending the bars shall be furnished by the Contractor. The bars shall be secured in position by suitable means, so they will not be displaced during the process of depositing or consolidating the concrete.

Steel reinforcement shall be stored on the Work site in such a manner as to protect it from any damage or surface deterioration.

Cold bends shall be made around a pin having a diameter of not less than 6 times the nominal diameter of the bar.

All reinforcing steel shall be furnished in full length, except where splices are indicated in the plan or permitted by the City's Project Manager. Splices in adjacent bars shall be staggered.

21.06 REINFORCED CONCRETE BOX STORM DRAINS AND STRUCTURES (Continued)

C. STEEL REINFORCEMENTS (Continued)

Unless otherwise shown in the plans, bars shall be spliced by lapping the ends. Laps shall be 36 bar diameters for Grade 60 (420), and 24 bar diameters for Grade 40 (300). Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment, and clearance.

D. CONCRETE

1. Placing Concrete

Before depositing any concrete, all dirt and other debris shall be removed from the forms. Concrete shall be handled by methods which will prevent the separation or loss of ingredients and the formation of laitance. The concrete shall be deposited in the Work as nearly as possible in its final position to avoid rehandling. The concrete shall be deposited in level layers not exceeding 12" in thickness. Suitable means shall be provided to permit concrete to be placed in a manner that will avoid accumulation of dry or hardened concrete on the forms or reinforcement. Concrete, during and immediately after depositing, shall be thoroughly consolidated by the use of vibrators specified below. The greatest care must be exercised to ensure the coating of all surfaces of the reinforcement. Equal care shall be taken to ensure that all concrete is consolidated against the face of the forms.

2. Keyed Construction Joints

All keyed joints shall be of the raised type, and shall be thoroughly cleaned prior to successive concrete placements.

3. Curing Concrete

Precautions shall be taken to prevent excess loss of water from the concrete. The top of the floor slab and the top of the roof shall be sealed immediately after finishing by wet burlaps, plastic, or by spraying thereon a uniform application of membrane compound conforming to "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete" ASTM Designation C 309 for Type 2, and at approximately the rate of 1 gallon to each 150 square feet of surface. The area of the floor slab that will support the walls shall be cured with wet burlap or plastic sheeting. All exposed dowels in the floor slab shall be protected during the curing operation. When forms are removed before the concrete has reached an age of 7 days, the exposed concrete shall be cured as specified above.

4. Surface Finish

The upper surface of the floor slab and the top of the roof and end walls shall be finished straight and smooth to the designated lines and slopes. They shall be finished with floats and/or steel trowels. Exposed edges shall be chamfered a minimum of 1" or as otherwise directed by the City's Project Manager. All exposed surfaces shall be finished with a Carborundum stone and water as soon as forms are removed. Upon removal of the forms, should any voids or other defects exist in the concrete surfaces, such defective concrete shall be removed at once and the space refilled with concrete and finished in a neat and workmanlike manner.

21.06 REINFORCED CONCRETE BOX STORM DRAINS AND STRUCTURES (Continued)

D. CONCRETE (Continued)

5. Backfill for Reinforced Concrete Box Storm Drains and Structures

Backfill along the sides of the reinforced box or structure shall not be made until tests show that the concrete has developed a compressive strength of 2000 p.s.i. Backfill over the top of the reinforced concrete box or structure shall not be made until tests show that the concrete has developed a compressive strength of 3000 p.s.i. Tests and test specimens shall comply with current ASTM standards. In the absence of tests, the following times shall elapse prior to backfilling:

<u>MINIMUM AVERAGE AMBIENT TEMPERATURE</u>	<u>TIME</u>
45° F	17 Days
55° F	8 Days
73° F	5 Days

E. BASIS OF PAYMENT

When called for in the proposal, payment for reinforcing steel for reinforced concrete box storm drains and structures placed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be made at the contract unit price bid per pound for REINFORCING STEEL FOR BOX STORM DRAIN, IN PLACE, or for REINFORCING STEEL FOR STRUCTURES, IN PLACE. The reinforcing steel shall not be measured separately for payment, but the quantities shall be established based upon weight of steel required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all placing, tying, chairs, materials, equipment, tools, labor, and incidentals necessary to place the steel in the proper locations in conformance with the plans.

When the plans or Special Provisions provide for unit price bids per linear foot or lump sum complete for box storm drains or structures, the reinforcing steel shall not be paid for separately. The cost of the reinforcing steel shall be considered subsidiary to the costs for the items bid on the linear foot or lump sum basis as provided in Chapter 21 of these Standard Specifications.

When called for in the proposal, concrete for box storm drains or structures placed in conformance to these Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per cubic yard for CONCRETE FOR BOX STORM DRAIN, IN PLACE, or for CONCRETE FOR STRUCTURES, IN PLACE. The concrete shall not be measured separately for payment, but the quantities shall be established based upon the volume of concrete required for the Design Section, unless otherwise specified. Such payment shall be full compensation for all mixing, hauling, forming, placing, jointing, curing, finishing, excavation, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the structure.

When called for in the proposal, reinforced concrete box storm drains constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per linear foot for ___ X ___ REINFORCED CONCRETE BOX STORM DRAIN, COMPLETE, for the various sizes required. Such payment shall be full compensation for all excavation, bedding where required, forming, placing reinforcement, placing concrete, jointing, curing, finishing, backfill, materials, equipment, tools, labor, and incidentals necessary to construct the box and its appurtenances.

21.06 REINFORCED CONCRETE BOX STORM DRAINS AND STRUCTURES (Continued)

E. BASIS OF PAYMENT (Continued)

When called for in the proposal, reinforced concrete structures constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be paid for at the contract unit price bid per lump sum for REINFORCED CONCRETE TRANSITION STRUCTURE @ STA. ___, COMPLETE, or REINFORCED CONCRETE STRUCTURE @ STA. ___, COMPLETE. Such payment shall be full compensation for all excavation, bedding where required, forming, placing reinforcement, placing concrete, jointing, curing, finishing, backfill, materials, equipment, tools, labor, and incidentals necessary to construct each structure and its appurtenances in a manner acceptable to the City's Project Manager.

21.07 STORM DRAIN MANHOLES

A. BRICK MANHOLES

Brick manholes shall be built where and as indicated on the plans. Their form and dimensions shall be in conformance with the drawings included with these Standard Specifications. The brick in each course shall break course with those in the adjoining courses. Mortar shall be mixed in the proportions of 1 part of Portland or mortar cement and 2 parts of sand, by volume. Every brick shall have full mortared joints on the bottom, sides and ends which shall be formed in one operation by placing sufficient mortar on the bed and forcing the brick into it. All joints shall be carefully filled and struck as the manhole is built up. The entire space between adjacent bricks shall be filled solidly with mortar. The entire inside and outside surface of the brick masonry shall be carefully plastered with mortar applied at a thickness of not less than 1/2".

Reinforced concrete manholes or precast concrete manholes shall be used, but not brick manholes, when the manhole depth is greater than 8 feet, measured from the flowline of the lowest pipe to the cast iron rim.

B. REINFORCED CONCRETE MANHOLES

Reinforced concrete manholes shall be built in conformance with Chapter 21 of these Standard Specifications.

C. PRECAST CONCRETE MANHOLES

Concrete manholes may also be constructed of precast sections as provided in the Lincoln Standard Plans. In the assembly of the wall rings, mortar joints, rubber gaskets, or cold-formed asphalt, joints shall be used to make the walls watertight.

D. BASIS OF PAYMENT

Storm drainage manholes constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for STORM DRAIN MANHOLE, ___INCHES, COMPLETE, for the various sizes required. Size of the manhole shall be identified as the largest nominal size of its intersecting storm drains. Such payment shall be full compensation for all excavation, brick, mortar, castings, precast sections, reinforcement, concrete, backfill, materials, equipment, tools, labor, and incidentals necessary to complete each manhole.

21.08 STORM DRAIN INLETS

A. GENERAL

Storm drain inlets shall be constructed where and as indicated on the plans. Walls shall be made of either brick masonry or reinforced concrete. Brick masonry walls shall be built as specified above for Brick Manholes. Reinforced concrete walls shall be built as specified above for Reinforced Concrete Manholes and Chapter 21 of these Standard Specifications.

Each inlet bottom shall be fully formed so as to make the curves of the tributary drains, and all corners shall be filled with concrete as directed by the City's Project Manager.

All cast iron inlet rings, covers, grates, and the forms and dimensions of all inlets shall comply with the Lincoln Standard Plans. The ring and cover shall be adjusted to grade with brick and mortar and shall be sealed inside and out with mortar.

Reinforcing steel shall be epoxy coated and conform to the materials and construction methods of the Standard Specifications.

Each inlet shall include a length of curb and gutter as called for on the Standard Plans. Curb faces shall be transitioned gradually and uniformly to the inlet top face within 2' of the inlet top. When transitioning curb to an armored inlet top, the curb face adjacent to the inlet top should be similar to a barrier style curb with 8" vertical face.

The concrete gutter along the entire length of the inlet opening shall be constructed to form the inlet throat in accordance to the geometrics on the Inlet Throat Depression Template and per Lincoln Standard Plans.

B. STANDARD INLET TOPS

All inlet tops shall be precast reinforced concrete in accordance with the Lincoln Standard Plans. Inlet tops shall be set to grade and sealed with mortar. The Contractor shall make all necessary adjustments to the shoulder and walls in order to set the new inlet top at the proper grade.

Inlet tops shall be placed such that a minimum of 5" inlet throat opening is established per plans, and the top of the inlet aligns with adjacent back of curb elevations. Inlet tops shall be placed in a manner that minimizes interference with snow plow operations. The faces of all inlet tops shall in no instance protrude beyond the normal gutter line or adjacent curb faces.

C. ARMORED FACE INLET TOPS

Armored face inlet tops shall be constructed in the same manner as Standard Inlet Tops as specified above, with the addition of metal face armoring. The metal face armoring assembly shall be fabricated from steel channel and rebar and shall be galvanized per the Lincoln Standard Plans and conform to the materials and construction methods of these Standard Specifications.

21.08 STORM DRAIN INLETS (Continued)

D. RECONSTRUCT INLET THROATS AND RECONSTRUCT INLET VAULTS

Inlet throats shall be reconstructed in the same manner as an inlet throat is constructed for a new inlet in accordance with the City of Lincoln Standard Plans. The concrete gutter along the entire length of the inlet opening shall be constructed to form the inlet throat in accordance to the geometrics on the Inlet Throat Depression Template and per City of Lincoln Standard Plans.

Inlet vaults shall be reconstructed in the same manner as an inlet vault is constructed for a new inlet in accordance with the City of Lincoln Standard Plans. Vault walls shall be reconstructed with either brick or reinforced concrete, based on the type of material the existing vault is constructed of.

E. BASIS OF PAYMENT

Storm drainage inlets constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for STORM DRAIN INLET, 72"; CANTED STORM DRAIN INLET, 72"; RADIUS STORM DRAIN INLET, 72"; GRATE INLET, TYPE __, for the various sizes and types required. Such payment shall be full compensation for all excavation, brick, mortar, concrete, epoxy coated steel, standard inlet top, castings, curb and gutter as called for on the Standard Plans, backfill, materials, equipment, tools, labor, and incidentals necessary to complete each inlet.

Armored face storm drainage inlets constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for STORM DRAIN INLET, 72" ARMORED FACE; CANTED STORM DRAIN INLET, 72" ARMORED FACE. Such payment shall be full compensation for all excavation, brick, mortar, concrete, epoxy coated steel, armored face inlet top, castings, curb and gutter as called for on the Standard Plans, backfill, materials, equipment, tools, labor, and incidentals necessary to complete each inlet.

Storm drainage inlet tops constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for STORM DRAIN INLET TOP ONLY, 72"; STORM DRAIN INLET TOP ONLY, 72" ARMORED FACE. Such payment shall be full compensation for excavation, brick, mortar, concrete, epoxy coated steel, metal face armoring assembly (when called for), castings, cast iron frame and cover, labor, tools, equipment, all other materials, and all other incidentals necessary to complete placement of inlet top. Item includes the work necessary to place only the concrete inlet top on existing storm drain vaults as indicated on the Plans.

Inlet throats and vaults reconstructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for RECONSTRUCT INLET THROAT; RECONSTRUCT INLET VAULT. Such payment shall be full compensation for all removals, brick, mortar, concrete, epoxy coated steel, labor, tools, equipment, all other materials, and all other incidentals necessary to complete the reconstruction.

21.09 CONVERT INLET TO MANHOLE

A. GENERAL

When called for on the plans, existing inlets shall be converted to manholes by removing the inlet top, throat and adjacent curbs, bricking up the throat, removing and reshaping the invert if necessary, placing a new inlet top, and installing a new manhole ring and cover as directed by the City's Project Manager.

B. BASIS OF PAYMENT

Inlets converted to manholes shall be paid for at the contract unit price bid per each for CONVERT INLET TO MANHOLE, COMPLETE. Such costs shall be full compensation for all excavation, backfill, curb removal, curb replacement, materials, equipment, tools, labor, and incidentals necessary to complete each conversion.

21.10 OPEN DITCHES

A. GENERAL

Open ditches shall be constructed in conformance with the lines and grades indicated on the plans and/or as directed by the City's Project Manager.

B. BASIS OF PAYMENT

Open ditches constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured using the end area method and shall be paid for at the contract unit price bid per cubic yard for CHANNEL EXCAVATION. The quantity to be used as the basis for payment shall be the quantity called for in the proposal, unless otherwise specified. Such payment shall be full compensation for all excavation, preparation of the banks for seeding when required, disposal of surplus materials, other materials, equipment, tools, labor, and incidentals necessary to complete the ditch or channel.

When indicated on the plans but not called for in the proposal, the cost of grading small ditches or reshaping ditches, as directed by the City's Project Manager, shall not be measured or paid for directly. The cost of this Work shall be considered subsidiary to the cost of the other items for which direct payment is made.

21.11 CONCRETE LINERS

A. GENERAL

Concrete liners for open ditches shall be built to lines, grades, and sections as shown on the plans.

B. BASIS OF PAYMENT

Concrete ditch and channel liners constructed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for RC LOW FLOW LINER,____', for the various sizes required. Such payment shall be full compensation for all excavation, forming, reinforcement, concrete, finishing, jointing, curing, sealing, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the liners.

21.12 REINFORCED CONCRETE FLARED END SECTIONS (RC FES)

A. GENERAL

When called for on the plans, reinforced concrete flared end sections, with or without grates, shall be installed at the locations and grades indicated.

When called for on the plans, flared end sections shall be removed and salvaged to a location on the job site as directed by the City's Project Manager.

When called for on the plans, the Contractor shall remove existing flared end sections from the existing system, store the end sections on the job site, and reset the end sections at new locations as a part of the Work.

Flared end sections required to be removed and salvaged or removed and reset but damaged by the Contractor shall be replaced with new materials at the Contractor's cost.

Flared end sections to be removed and not salvaged or reset shall be disposed of by the Contractor.

B. BASIS OF PAYMENT

Flared end sections to be removed or removed and reset, in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be counted and paid for at the contract unit price bid per each for REMOVE RC FES, __" or REMOVE AND RESET RC FES, __". Such payment shall be full compensation for all excavation, backfill, bedding, jointing, materials, equipment, tools, labor and incidentals necessary to install the end sections at the locations shown on the plans, or to remove and salvage, remove and reset, or remove and dispose of the end sections.

Flared end sections and flared end sections with grates, placed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be counted and paid for at the contract unit price bid per each for RC FES, __" and RC FES, w/GRATE, __" ; for the various sizes called for in the proposal.

21.13 REMOVAL OF EXISTING STRUCTURES

A. GENERAL

When called for on the plans the Contractor shall remove appurtenant structures from the existing system. The resultant exposed ends of the system shall be either made ready to connect system extensions or plugged with permanent or temporary plugs, as indicated.

B. BASIS OF PAYMENT

The removal of existing appurtenant structures as called for on the plans, completed in conformance with these Standard Specifications and accepted by the City's Project Manager, shall be counted and paid for at the contract unit price bid per each for REMOVE EXISTING MANHOLE, COMPLETE; REMOVE EXISTING INLET, COMPLETE; REMOVE EXISTING JUNCTION BOX, COMPLETE; REMOVE EXISTING GRATE INLET, COMPLETE; REMOVE EXISTING HEADWALL, COMPLETE; or REMOVE EXISTING INLET TOP ONLY. No classifications shall be made as to size of the structure or appurtenance. Such payment shall be full compensation for all excavation, removal to the line indicated, salvage of inlet tops if required, plugging, preparation of existing surfaces, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the removal.

21.14 RIP-RAP

A. GENERAL

Rock rip-rap shall be placed on prepared slopes and channel bottoms at locations shown on the plans. The materials used shall be hard stone, or prepackaged material, free from earth, clay, asphalt or refuse and of such quality that it will not disintegrate from action of water or wind. Sizes of the material shall be graded as shown in Table 21.14 A.

The rock shall be angular in shape to allow interlocking between the various rock sizes.

TABLE 21.14 A – ROCK RIP-RAP GRADATION REQUIREMENTS

Size of Rock	Percent of Total Weight Smaller than the Given Size	Approx. Rock Size D50	Approx. Rock Size Dmax
Type A		0.77ft	1.28ft
150 lbs	100		
35 lbs	50		
2 lbs	Not to exceed 10		
Type B		1.02 ft	1.61 ft
300 lbs	100		
80 lbs	50		
5 lbs	Not to exceed 10		
Type C		1.28 ft	2.12 ft
700 lbs	100		
150 lbs	50		
10 lbs	Not to exceed 10		

Rock Rip-Rap can be place with geotextile filter fabric or with a rock filter layer as directed by the Engineer. Geotextile conforming to the requirements of Chapter 32 of these Standard Specifications shall be placed on the prepared slopes prior to placement of the rip-rap.

Concrete or other masonry produced as a result of removal of such items at the job site may not be used as a substitute for rip-rap.

The rip-rap shall be placed at the locations and thicknesses indicated on the plans. Any appreciable variation from specified thickness shall be corrected by redistributing the rip-rap.

B. BASIS OF PAYMENT

Rip-rap placed in conformance with these Standard Specifications and accepted by the City's Project Manager shall be measured by weighing the truck. Net weight shall be the basis of payment. Payment shall be made at the contract unit price bid per ton for RIP-RAP, TYPE __. When using filter fabric, payment shall be made at a contract unit price bid per ton for RIP RAP, TYPE __ WITH FILTER FABRIC. Placement of the geotextile filter fabric shall be considered subsidiary to the placement of the rip-rap. No measurement or payment shall be made for rip-rap produced as a result of removal of other items on the project. Such payment shall be full compensation for furnishing, preparation of slopes and subgrades, hauling, placing, excavation, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the Work.

21.15 GABION INSTALLATION

A. GENERAL

The Contractor shall furnish, assemble, tie, and fill gabion constructed in conformance with these Standard Specifications and placed in conformity with the lines, grades, and dimensions shown on the plans or as directed by the City's Project Manager. The location for installation of each type of gabion is indicated on the plans.

B. CONSTRUCTION

1. Assembly

Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately 6" spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every 4".

2. Placement

Prior to placement of gabion, the surface on which the gabion will bear shall be compacted and trimmed. Empty gabion units shall be set to line and grade as shown on the plans. Wire ties or connecting wire shall be used to join the units together. The units shall be tied together at all edges of their contact perimeters. Internal tie wires shall be uniformly spaced and securely fastened in each outside cell of the structure or where ordered by the City's Project Manager. A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.

3. Filling and Closing

The gabion shall be filled with the approved stone carefully placed by hand or machine to assure alignment and avoid bulges with a minimum of voids. Hand placing of the rock fill shall be used in the exposed faces of the gabion so that a pleasing and orderly arrangement of fill will result. The gabion shall be overfilled approximately 2" above the sides prior to closing the lids. The lid shall then be secured to the sides, ends, and diaphragms with the wire ties or connecting wire. Special attention shall be given to see that all projections or wire ends are turned into the baskets.

C. BASIS OF PAYMENT

The Contractor shall be paid for the actual number of baskets placed and filled at the contract bid price per each for WIRE GABION, TYPE _____, IN PLACE or WIRE GABION PVC COATED, TYPE _____, IN PLACE. Such payment shall constitute full compensation for all costs of labor, equipment, tools, and materials for furnishing, assembling, filling with stone, closing, all channel excavation, backfilling, and all incidental Work necessary to complete the construction in conformance with these Standard Specifications and as shown on the Plans.

21.16 GEOTEXTILE FILTER FABRIC INSTALLATION

A. GENERAL

The Work covered by these Standard Specifications shall consist of furnishing all labor, materials, and equipment necessary for installing geotextile filter fabric as shown on the plans.

B. CONSTRUCTION

1. Weep Holes

Geotextile filter fabric shall be placed at weep holes for channel liners and retaining walls as shown on the plans.

2. Gabion/Embankment Stabilization

The gabion/embankment stabilization fabric shall be placed in the manner and at the locations shown on the project plans. The surface to receive the geotextiles shall be prepared to a smooth condition free of obstructions, depressions and debris. The fabric shall be placed loosely, not in a stretched condition. The gabions shall be placed so that the geotextile is not punctured. The gabions shall completely cover the fabric.

The fabric shall be placed on the slopes so as to provide a minimum overlap of 18". The geotextile shall be placed parallel to the direction of the flow and the upstream or higher panel shall overlap the downstream or lower panel. At the top of the embankment the fabric shall be keyed into the ground a minimum of 18".

The filter fabric shall be placed in the manner and at the locations shown on the project plans. The fabric shall be placed loosely, on and/or behind the gabion, not in a stretched condition. The backfill shall be placed so that the fabric is not punctured.

C. BASIS OF PAYMENT

No additional payment shall be made for filter fabric used in constructing weephole filter pockets for R.C. Channel Liner. The filter fabric and placement shall be considered subsidiary to the cost of the R.C. Channel Liner of the various depths.

Unless shown in the schedule of quantities as a bid item, no additional payment shall be made for filter fabric placed on, behind, or under gabion. All costs of materials, labor, and equipment for furnishing and placing the filter fabric with the gabion, as shown on the plans, shall be considered subsidiary to the cost of the Gabion, In Place, of the various types.

When shown in the schedule of quantities as a bid item, geotextile filter fabric, placed in conformance with the plans and these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per square yard for GEOTEXTILE FILTER FABRIC, IN PLACE, with no allowance for laps or toe-in anchorage. Such payment shall be full compensation for all filter fabric, slope preparation, installing the fabric, equipment, materials, tools, labor, and incidentals necessary to complete the Work.

21.17 TIED CONCRETE BLOCK MAT INSTALLATION

A. GENERAL

The Contractor shall furnish and place tied concrete block mats constructed in conformance with these Standard Specifications and placed in conformity with the lines, grades, and dimensions shown on the plans or as directed by the City's Project Manager.

B. MATERIALS

Tied concrete block mats are manufactured from individual concrete blocks tied together with high strength polypropylene biaxial geogrid. Each block is tapered, beveled and interlocked and includes connections that prevent lateral displacement of the blocks within the mats when they are lifted for placement. Tied concrete block mats shall be Flexamat, manufactured by Motz Enterprises, Inc. or approved equal.

1. Block

Furnish blocks manufactured with concrete conforming to the cement requirements of ASTM C150 and to the aggregate requirements of ASTM C33. Meet a minimum compressive strength of 5,000 psi at 28 days. Furnish blocks that have a minimum weight of 3 lb. per block and placed no further than 2 in. apart.

2. Polypropylene Bi-Axial Geogrid

The geogrid will be composed of Polypropylene multifilament yarns coated with an acrylic based coating which is designed to resist degradation in environments with exposure to water and low pH (<4 pH) and high pH (>9 pH). When combined with the revetment mat this will yield a high tenacity, low elongating, and continuous filament polypropylene fibers that is securely cast into and embedded within the base of the concrete blocks and obtains connection strength greater than that of the geogrid. Ensure the geogrid meets the following requirements:

- UV Stabilization – 2% Carbon Black
- Ultimate Tensile Strength – 2055 lb/lf

3. Underlayment Materials

The underlayment material shall be specified by the engineer, and shall be either Leno Weave Fabric, Curlex II or Recyclex TRM-V, or an approved equal. The backing material shall be packaged within the roll of the tied concrete block mats.

Cover the mat or otherwise protect it during long periods of storage to protect against degradation of the backing material as recommended by the manufacturer.

Mats will be rolled for shipment and are packaged with handling straps. These handling straps shall only be used for lifting below 2 ft. to place heavy duty lifting straps under rolls. Upon delivery, rolls may be left exposed for up to 30 days. If exposure will exceed 30 days, cover or tarp the rolls to minimize UV exposure.

All mats to be inspected upon delivery. Assure that all units are sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction.

Chipping or missing concrete resulting in a weight loss exceeding 15% of the average weight of a concrete unit is grounds for rejection by the engineer. Replace, repair or patch the damaged areas per the manufacturer's recommendations.

21.17 TIED CONCRETE BLOCK MAT INSTALLATION (Continued)

C. CONSTRUCTION

1. Equipment

Provide the proper equipment to place the mat that will not damage the mat material or disturb the top soil subgrade and seed bed.

2. Preparation

Prior to installation, prepare the subgrade as detailed in the plans. All subgrade surfaces to be smooth and free of all rocks, stones, sticks, roots, and other protrusions or debris of any kind that would result in an individual block being raised more than 3/4 in. above the adjoining blocks. When seeding is shown on the plans, provide subgrade material that can sustain growth.

Ensure the prepared subgrade provides a smooth, firm, and unyielding foundation for the mats. The subgrade shall be graded into a parabolic or trapezoidal shape to concentrate flow to middle of mat or mats.

When vegetation is required, distribute seed on the prepared topsoil subgrade before installation of the concrete mats in accordance with the specifications.

3. Placement

Install mats to the line and grade shown on the plans and per the manufacturer's guidelines. The manufacturer or authorized representative will provide technical assistance during the slope preparation and installation of the concrete block mats as needed.

Provide a minimum 18 in. deep concrete mat embedment toe trench at all edges exposed to concentrated flows. Recess exterior edges subject to sheet flow a minimum of 3 in.

When needed, provide fastening or anchoring as recommended by the manufacturer or engineer for the site conditions.

For seams parallel to the flow line in ditch or channel applications, center a minimum 3 ft. wide strip of soil retention blanket under the seam. Fasten along the seam at 5 ft. maximum spacing. Parallel seams in the center of the ditch shall be avoided when possible.

Shingle seams perpendicular to the flow line with the downstream mat recessed a minimum of 2 blocks under the upstream mat and fastened together along the seam at 2 ft. maximum spacing if required by manufacturer or engineer.

D. BASIS OF PAYMENT

Payment shall be made at the contract unit price bid per square foot for TIED CONCRETE BLOCK MAT. Such payment shall be full compensation for furnishing, preparation of slopes and subgrades, hauling, placing, excavation, backfill, materials, equipment, tools, labor, and incidentals necessary to complete the Work.

21.18 SUBSTANTIAL COMPLETION

Storm drainage Work shall be considered substantially complete when all pipe is laid and backfilled; all manholes, inlets, and structures completed and backfilled; paving, sidewalks, and driveways replaced.

21.19 FINAL ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required Work is complete and accepted by the City's Project Manager, all items on plan completed, final cleanup is complete, park space finished, and correction of all deficiencies found as a result of testing and/or final inspection by the City's Project Manager.

21.20 GUARANTEE

At any time during the two-year guarantee period, and within the time period allowed, the Contractor shall correct any defect in material or workmanship which has been brought to his attention. Such items shall include but not be limited to trench settlement including subsequent pavement damage, pipe leaks, and failures.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 22

SANITARY SEWERS

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CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 22

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CHAPTER 22

SANITARY SEWERS

22.00 GENERAL

The Work covered in this chapter shall include the installation of sanitary sewers and their appurtenances.

A. REFERENCED STANDARDS

1. ASTM A48/48M – Standard Specification for Gray Iron Castings
2. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
3. ASTM C361 – Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
4. ASTM C425 – Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
5. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
6. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
7. ASTM C655 – Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
8. ASTM C700 – Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
9. ASTM C877 – Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
10. ASTM C828 – Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
11. ASTM C900 – Standard Test Method for Pullout Strength of Hardened Concrete
12. ASTM C920 – Standard Specification for Elastomeric Joint Sealants
13. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
14. ASTM C969 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
15. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
16. ASTM C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

22.00 GENERAL (Continued)

A. REFERENCED STANDARDS (Continued)

17. ASTM C1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems
18. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
19. ASTM C1619 – Standard Specification for Elastomeric Seals for Joining Concrete Structures
20. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
21. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
22. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
23. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
24. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
25. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
26. ASTM D3262 – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
27. ASTM D3575 – Standard Text methods for Flexible Cellular Materials Made From Olefin Polymers
28. ASTM D3681 – Standard Test Method for Chemical Resistance of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
29. ASTM D3753 – Glass-Fiber Reinforced Polyester Manholes and Wetwells
30. ASTM D4161 – Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
31. ASTM D4819-13 – Standard Specification for Flexible Cellular Materials Made From Polyolefin Plastics
32. ASTM F1417 – Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
33. ASTM F2764 – Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications

22.00 GENERAL (Continued)

A. REFERENCED STANDARDS (Continued)

34. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
35. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
36. ASTM F594 – Standard Specification for Stainless Steel Nuts
37. ASTM F679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
38. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

22.01 MATERIALS

The materials listed in this article are approved for use in the City of Lincoln pursuant to the Standard Specifications described herein. Developers, consultants, and Contractors may request consideration of alternate materials to the Director of the Transportation and Utilities Department. Only one type of pipe shall be used between manholes on each project unless specifically called for on the plans or authorized by the City's Project Manager.

A. VITRIFIED CLAY PIPE (VCP) - 8" to 48" Gravity Pipe

1. Pipe and Fittings (Extra Strength): ASTM C700.
2. Compression Joints: ASTM C425, polyester or polyurethane material factory applied to both the bell and spigot or plain end of every pipe.

B. CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR PIPE (CCFRPM) - 18" to 104" Gravity Pipe

1. Pipe and Fittings: ASTM D2412, ASTM D3262, and ASTM D3681.
2. Pipe Joints: ASTM D4161, field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness.
3. Elastomeric Gaskets: ASTM F477, supplied by qualified gasket manufacturers and be suitable for the service intended.

C. SOLID WALL POLYVINYL CHLORIDE (PVC) - 8" to 60" Gravity Pipe

1. Pipe and Fittings 15 IN and smaller: ASTM D3034, DR 35 minimum.
2. Pipe and Fittings 18 IN through 60 IN: ASTM F679.
3. Pipe Joints: Integral bell and spigot joints with elastomeric seals complying with ASTM D3212 and ASTM F477.
4. Laying Lengths: All pipe shall be furnished in standard laying lengths.

22.01 MATERIALS (Continued)

D. REINFORCED CONCRETE PIPE (RCP) - 48" to 144" Gravity Pipe

1. Certification:

Manufactured by a plant certified under the American Concrete Pipe Association's (ACPA) "Quality Cast" Plant Certification Program. All RCP delivered to the jobsite shall be stamped with the "Q-Cast" certification stamp.

2. Pipe:

- a. ASTM Designation C76 or C-655 as specified on the plans or Special Provisions, except as herein provided.
- b. Circular in cross-section.
- c. The coarse aggregate used in the manufacture of the RCP shall conform to the requirements of Article 11.01.
- d. All RCP shall have an antimicrobial admixture: 1 gallon per cubic yard of concrete of Con^{mic}Shield® by Conshield Technologies Inc. Additive shall be included in the concrete mix design as part of the total water content. The additive shall be added to the concrete mix water to ensure even distribution throughout the concrete mixture.

3. Pipe Joints: ASTM C361 and ASTM C1619. Elastomeric seal shall be Class B.

- a. Joints shall be water tight with no visible water leaking or weeping from the joint.

4. Laying Lengths: All pipe shall be furnished in standard laying lengths.

5. Lifting holes will not be allowed.

E. POLYPROPYLENE (PP) - 12" to 42" Gravity Pipe

1. Pipe and Fittings 12 IN through 30 IN: dual wall, ASTM F2764, ASTM D2412 minimum PS of 46 pounds/inch/inch.
2. Pipe and Fittings 30 IN through 42 IN: triple wall, ASTM F2764, ASTM D2412 minimum PS of 46 pounds/inch/inch.
3. Pipe Joints: Integral bell and spigot joints complying with ASTM F2764. Watertight seals complying with ASTM D3212, with the addition of a 15-psi pressure requirement.
4. Laying Lengths: All pipe shall be furnished in standard laying lengths of 13 feet and 20 feet.

F. POLYVINYL CHLORIDE (PVC) - 4" to 60" Pressure Pipe

1. Pipe and Fittings: AWWA C900, ASTM D1784. Pressure class of pipe shall be as indicated in the Contract Documents.
2. Joints: ASTM D3139 with a push-on joint and ASTM F477.
3. Laying Lengths: All pipe shall be furnished in standard laying lengths of 14 feet.

22.01 MATERIALS (Continued)

G. OTHER SEWER PIPE

1. Other sewer pipe material may be authorized only by special permission from Lincoln Wastewater.

H. PRECAST CONCRETE MANHOLE

1. As per the Lincoln Standard Plans.
2. Circular precast: ASTM C478.
3. Base:
 - a. Integral base with riser wall and base slab cast monolithically as a single unit with benching.
 - b. Base consisting of a riser section with a secondary poured integral base slab with benching.
4. Minimum inside dimension of 48 IN.
5. Flexible watertight connector: ASTM C923.
6. Joint sealants:
 - a. Rubber O-ring or profile gasket complying with ASTM C443.
 - b. Exterior cold-applied mastic compound recommended by the manufacturer and complying with ASTM C990 or Butyl Sealant Wrap complying with ASTM C877.
7. Manholes on sanitary sewer trunk lines (15 inch or larger pipe) shall have an antimicrobial admixture.
 - a. Antimicrobial Admixture: 1 gallon per cubic yard of concrete of Con^{mic}Shield® by Conshield Technologies Inc. Additive shall be included in the concrete mix design as part of the total water content. The additive shall be added to the concrete mix water to ensure even distribution throughout the concrete mixture.

I. FIBERGLASS MANHOLE

1. As per the Lincoln Standard Plans.
2. Fiberglass: ASTM D3753. Use resin only from a single manufacturer.
3. Minimum inside dimension of 48 IN.
4. Flexible watertight connector: ASTM C923.
5. Manhole top: Shall have a fiberglass neck that extends inside grade rings to extend 1 IN past the flat surface of the manhole cone.

22.01 MATERIALS (Continued)

J. ADJUSTING RISERS

1. Reinforced concrete: ASTM C478, risers shall be free from cracks, voids, and other defects.
 - a. Use manufacturer's recommended adhesive.
 - b. Use antimicrobial admixture as outlined in 22.01 H7a. if manhole contains the admixture.
2. Polypropylene: ASTM D3575 and ASTM D4819-13.
 - a. Use manufacturer's recommended adhesive.
3. Adjusting riser shall be approved by City's Project manager prior to installation.

K. ADJUSTING RINGS

1. Polypropylene: ASTM D3575 and ASTM D4819-13.
 - a. Use manufacturer's recommended adhesive.
2. Adjusting ring shall be approved by City's Project Manager prior to installation.

L. EXTERNAL FRAME SEAL

1. Flexible external rubber sleeve: ASTM C 923.
2. Stainless steel compression bands: ASTM F593 and F594, Type 304.
3. External frame seal shall be approved by City's Project Manager prior to installation.

M. FRAME AND COVER

1. Frame and Cover: ASTM A48/48M, Class 35B.
2. Rated: Suitable for H-20 Traffic Loading.
3. As per the Lincoln Standard Plans.

N. WATERTIGHT FRAME AND COVER

1. To be used in areas prone to flooding, areas adjacent to creeks, and other areas as specified by the City's Project Manager.
2. Frame and Cover: Heavy Duty, R-1755-F2LM Frost/Watertight LiftMate Frame, Solid Gasketed Lid and Inner Lid, with hinge as manufactured by Neenah Foundry.
3. Furnish unit with manufacturer recommended anchoring system.

22.01 MATERIALS (Continued)

O. WASTEWATER SERVICE PIPE/PRIVATE SEWERS

1. Wastewater service pipe for new or reconstructed sanitary sewer services not owned by the City shall conform to the material requirements as provided in Title 24 of the Lincoln Municipal Code.

P. PIPE CONNECTIONS

1. Flexible watertight connector for pipes to manholes: ASTM C923.
2. Concrete collar for RCP pipe to RCP pipe connections: As per the Lincoln Standard Plans.
3. Connecting dissimilar pipe: ASTM C1173. Stainless steel clamped elastomeric couplings with stainless steel shielding band factory fabricated specifically for the use intended. The following manufacturers are acceptable:
 - a. Fernco Strong Back series or equal.

22.02 EXCAVATION, FOUNDATION, BEDDING AND BACKFILL

A. GENERAL

1. Trench excavation methods, pipe foundation materials, pipe bedding materials, pipe backfill materials and methods shall conform to Chapter 20 of these Standard Specifications, except as hereinafter modified for sanitary sewer construction.

22.03 CONNECTING NEW SANITARY TO EXISTING SANITARY

A. TAP EXISTING MANHOLE AND REPLACE INVERT

1. Maintain sewer service at all times.
2. Remove existing manhole channel/invert and bench.
3. Tap shall be core drilled through existing manhole wall. Exceptions to core drilling shall require approval by the City's Project Manager prior to construction.
4. Install flexible watertight connector into new opening.
5. Insert pipe through flexible connector. Pipe is allowed to penetrate inside wall of structure a maximum of two inches.
6. Reconstruct invert flow channel and bench in existing manhole.

B. CONVERT EXISTING MANHOLE TO DROP MANHOLE

1. Obtain approval from the City's Project Manager.
2. Construct drop as per the Lincoln Standard Plans.
3. Maintain sewer service at all times.
4. Remove existing manhole channel/invert and bench.
5. Taps shall be core drilled through existing manhole wall. Exceptions to core drilling shall require approval by the City's Project Manager prior to construction.
6. Install flexible watertight connector into new openings.
7. Insert pipes through flexible connector. Pipe is allowed to penetrate inside wall of structure a maximum of two inches.
8. Install other pipes and fittings for outside drop structure.
9. Place concrete encasement on crushed rock.
10. Reconstruct invert flow channel and bench in existing manhole.

C. CONNECTING DISSIMILAR PIPE

1. Contractor shall connect dissimilar pipe as per 22.01 and per City's Project Manager approval.
2. Unless specifically designated in the contract documents, connecting dissimilar pipe shall not be paid for separately. The cost of these items shall be considered subsidiary to the other items for which direct payment is made.

22.03 CONNECTING NEW SANITARY TO EXISTING SANITARY (Continued)

D. TEMPORARY SEWER PLUGGING REQUIREMENTS

1. Install plugs in the appropriate locations of all new sanitary sewers prior to, or during construction, and remove the plugs after construction using approved plugging methods and types to prevent any and all storm runoff, ground water and other foreign material from entering wastewater collection lines.
2. Check each plug daily and, if required, immediately take corrective action by repairing or replacing the plugs, as applicable to the situation.
3. Unless specifically designated in the contract documents, temporary sewer plugging shall not be paid for separately. The cost of these items shall be considered subsidiary to the other items for which direct payment is made.

E. MANHOLE REMOVAL

1. Verify with City's Project Manager the manhole is not in use.
2. Excavate as necessary to accomplish the required removal.
3. Saw cut a true line to separate the pipes from the manhole.
4. Completely remove and dispose of existing manhole.
5. Construct concrete sewer plugs by filling the end of the pipes with concrete as per the Lincoln Standard Plans.
6. Backfill and compact the resulting voids in conformance with Chapter 20 of these Standard Specifications.

F. MANHOLE ABANDONMENT

1. Verify with City's Project Manager the manhole is not in use.
2. Excavate as necessary to accomplish the required removal.
3. Remove the upper portion of the structure to a minimum of three feet below the proposed finished elevation of the surrounding ground.
4. Remove all rubble and debris from the remaining portion of the structure.
5. Fill manhole with approved backfill material, compacted in the abandoned manhole to the densities in conformance with Chapter 20 of these Standard Specifications.
6. Construct concrete sewer plugs by filling the end of the pipes with concrete as per the Lincoln Standard Plans.
7. Backfill and compact the resulting voids in conformance with Chapter 20 of these Standard Specifications.

22.03 CONNECTING NEW SANITARY TO EXISTING SANITARY (Continued)

G. BASIS OF PAYMENT

1. Reconstructed manholes built in conformance with these Standard Specifications and accepted by the City's Project Manager shall be counted and paid for at the contract unit price bid per each for TAP EXISTING MANHOLE AND REPLACE INVERT, or for CONVERT EXISTING MANHOLE TO DROP MANHOLE. Such payment shall be full compensation for all excavation, backfill, materials, equipment, tools, labor and incidentals necessary to complete the Work in accordance with the Contract Documents.
2. Plugging of existing sewer pipes shall be considered subsidiary to other items of Work for which direct payment is made. REMOVE EXISTING SANITARY SEWER MANHOLE shall be counted and paid for at the contract unit price bid per each. FILL AND ABANDON EXISTING MANHOLE shall be counted and paid for at the contract unit price bid per each. Such payments shall be full compensation for all excavation, backfill, materials, equipment, tools, labor and incidentals necessary to complete the Work in accordance with the Contract Documents.

22.04 ABANDONMENT OF SANITARY SEWER MAIN

A. GENERAL

1. Verify with City's Project Manager the sanitary sewer main is not in use.
2. Excavate as necessary to accomplish the required abandonment.
3. Construct concrete sewer plugs by filling the end of the pipes with concrete as per the Lincoln Standard Plans.
4. All sewer pipes beneath pavement shall be filled with flowable fill as specified in Chapter 3 of these Standard Specifications unless specifically designated otherwise in the contract documents.

B. BASIS OF PAYMENT

1. ABANDONMENT OF SANITARY SEWER MAIN shall be measured and paid for at the contract unit price per cubic yard. Such payment shall be full compensation for all labor, tools, materials, and incidentals necessary to complete the work in accordance with the Contract Documents.

22.05 PIPE INSTALLATION

A. DELIVERY, STORAGE, AND HANDLING OF PRODUCTS

1. Deliver, handle and store products in accordance with the manufacturer's instructions.
 - a. Protect PVC pipe from UV degradation if stored outside for more than the manufacturer's recommended number of days.
2. Protect pipeline sections stored at the site from damage.
3. Repair or replace any new pipe, fittings, and system appurtenances damaged before or during installation at Contractor's expense, before proceeding further.
 - a. Utilize repair methods as recommended by the manufacturer.
 - b. Replace damaged materials as directed by City's Project Manager.

B. LAYING THE PIPE

1. Excavate trench and provide pipe foundation materials, pipe bedding materials and pipe backfill materials as specified in Chapter 20 of these Standard Specifications.
2. Do not lay pipe in water or on saturated soil or bedding, or allow water to rise in trench around pipe prior to placing backfill material. Provide ground water management as specified in Chapter 20 of these Standard Specifications.
3. Install temporary watertight sewer plugs to prevent trench water, mud, dirt, or other foreign substances from entering the sanitary sewer system.
4. Clean pipe interior and joints prior to installation. Keep pipe clean during construction.
5. Begin at the lowest point in the line with the bell end pointing upstream.
6. Assemble joints.
 - a. Clean joint surfaces to remove soil or foreign material prior to joining pipe.
 - b. Assemble joints according to pipe manufacturer's recommendations.
7. Provide manholes as specified in the Contract Documents. Use a saw to cut ends of pipe flush with inside wall of manholes and structures. Do not use hammer or other means to break pipe.
8. Remove material at the bottom of the trench if determined to be unsuitable by the City's Project Manager.
9. Grade bottoms of trenches such that when bedding is placed between the trench bottom and the pipe, each section of pipe is installed to the specified depth or elevation with uniform support.
10. Determine and fix alignment and grade or elevation of each pipeline from offset stakes or calibrated laser instruments.
11. Calculate required elevation of each pipe joint and survey installed elevation at each joint prior to connecting the next joint to verify grade.

22.05 PIPE INSTALLATION (Continued)

B. LAYING THE PIPE (Continued)

12. Install pipelines on the line and grade shown on the drawings. Relay pipe to proper grade if any joint elevation deviates from the following tolerances:
 - a. Horizontal and vertical alignment shall not vary from design line and grade at any structure by more than 1% of the inside diameter of the pipe or ¼ inch, whichever is larger.
 - b. Horizontal alignment of the pipe shall not vary from design line at any point along the pipe by more than 1% of the inside diameter of the pipe.
 - c. Low spots holding water shall not exceed the following depths for each pipe size:

TABLE 22.05 A - PIPELINE TOLERANCES

Pipe Diameter	Maximum Low Spot Depth
8 IN	½ IN
10 IN	½ IN
12 IN	¾ IN
15 IN	¾ IN
18 IN and larger	5% of Pipe Diameter*

13. Do not disturb installed pipe and bedding when using movable trench boxes or supports. Block or anchor pipe as necessary to prevent joint displacement. Voids created by movement of trench boxes or supports shall be properly filled and compacted as described in Chapter 20 of these Standard Specifications.
14. Backfill trench with approved material as described in Chapter 20 of these Standard Specifications, provided all inspection and testing requirements are met.
15. Install wastewater service wyes at each location specified in the Contract Documents and detailed in the Lincoln Standard Plans.
16. Flexible piping construction shall be installed in conformance with ASTM D2321 and manufacturer recommended installation guidelines.

22.05 PIPE INSTALLATION (Continued)

C. CURVILINEAR ALIGNMENT

1. Bending of the pipe barrel to achieve curvilinear alignment shall not be permitted.
2. Follow the allowable joint deflection:
 - a. PVC: 1° of deflection at the joint. Standard 14 feet laying length has a minimum radius of 785 feet.
 - b. PP: 3° of deflection at the joint. Standard 13 feet laying length has a minimum radius of 248 feet and standard 20 feet laying length has a minimum radius of 382 feet.
 - c. RCP: As per manufacturer's recommendations.
 - d. VCP: As per manufacturer's recommendations.
 - e. Additional joint deflection using factory-made 3° couplings is allowed. The quantity and location shall be included in the Contract Documents and will not be determined in the field.

D. BASIS OF PAYMENT

1. All pipe of the various types shall be measured and paid for at the contract unit price bid for each size per linear foot for SANITARY SEWER PIPE, ____". All pipe shall be measured, center to center, through manholes. Said payment shall be full compensation for all excavations, backfill, testing, materials, equipment, tools, labor and incidentals necessary to install the pipe in accordance with the Contract Documents. Special measurement and payment for all fittings and pipe materials necessary to achieve desired radius, including beveled or radius pipe, will not be considered. The extra costs, if any, shall be merged with and considered subsidiary to the cost of the various sizes of pipe called for in the Contract Documents.
2. SANITARY SEWER PLUG, ____" shall be measured and paid for at the contract unit price bid per each for each type and size of sanitary sewer plug. This price shall be full compensation for all excavations, backfill, testing, labor, materials, tools, equipment and incidentals necessary to complete each type and size of sanitary sewer plug in accordance with the Contract Documents.
3. 3 DEGREE COUPLING, ____" shall be measured and paid for at the contract unit price bid per each for each type and size of 3-degree coupling. This price shall be full compensation for all excavations, backfill, testing, labor, materials, tools, equipment and incidentals necessary to complete each type and size of 3 degree coupling in accordance with the Contract Documents.

22.06 HIGHWAY, STREET, RAILROAD AND UTILITY CROSSINGS

A. GENERAL

1. Highway, street, railroad and utility crossings shall be constructed in accordance with the approved permit.
2. The City will obtain the necessary permits.
3. Encasements shall conform to Chapter 20 of these Standard Specifications.
4. In laying pressure type sewer pipe over/under a water main, the center of a standard length of pipe shall be centered with the centerline water main. See Chapter 23 of these Standard Specifications.

22.07 SANITARY MANHOLE CONSTRUCTION

A. DELIVERY, STORAGE, AND HANDLING OF PRODUCTS

1. Deliver, handle and store products in accordance with the manufacturer's instructions.
2. Store all products on level ground and not in mud or water.
3. Keep products free from dirt and other foreign matter.
4. Use approved lifting devices that will safely lift the weight of the manhole unit with applicable OSHA requirements safety factor.

B. GENERAL REQUIREMENTS FOR INSTALLATION

1. Excavate and provide foundation materials, bedding materials, and backfill materials as specified in Chapter 20 of these Standard Specifications.
2. Manhole construction shall conform to the Lincoln Standard Plans.
3. Install rubber plug or an approved non-shrink grout in lift holes.
4. Prepare subgrade to accurate elevation required to place manhole bedding material.

C. MANHOLE BASE, RISERS, AND CONE

1. Set the manhole base on a graded bedding making sure the flexible watertight connectors or pipe openings match design elevations. If necessary, pour anti-flotation concrete base.
2. Level the top of the manhole base in both directions.
3. Install each additional manhole component, ensuring each is plumb as installed before installing the next component.
4. Install manhole eccentric cone.

22.07 SANITARY MANHOLE CONSTRUCTION (Continued)

D. PIPE CONNECTIONS

1. Place flexible watertight connectors according to manufacturers' recommendation.
2. Install and bed pipes and connect to manhole. Install pipe flush with inside wall of structure. Place bedding and pipe embedment material as specified in Chapter 20 of these Standard Specifications.

E. MANHOLE JOINTS

1. Ensure joints are free of debris.
2. Install rubber O-ring or profile gasket.
3. Apply cold-applied mastic compound or butyl sealant wrap to exterior of all sanitary sewer manhole joints.

F. MANHOLE FLOW CHANNEL AND BENCH

1. Flow channel construction shall conform to the Lincoln Standard Plans.
2. Construct minimum manhole flow channel of one-half the pipe inner diameter to produce a smooth half-pipe shape between pipe inverts.
3. Slope the manhole bench no less than ½ IN per foot perpendicular to flow line.

G. MANHOLE ADJUSTING RISERS AND RINGS

1. On new and existing manholes, construct:
 - a. Maximum 21 inch adjusting riser.
 - b. Adjusting rings for the top 4 inches.
2. On manholes in paved areas, match the slope of the finished surface with sloped adjusting rings.
3. Bed each concrete adjusting riser with manufacturer's approved product.
4. Bed each polypropylene riser or ring with manufacturer's approved product and according to manufacturer's recommended installation procedure.

H. FRAME AND COVER

1. Install the frame and cover to place the cover at the elevation specified in the Contract Documents.

22.07 SANITARY MANHOLE CONSTRUCTION (Continued)

I. MANHOLE EXTERNAL FRAME SEAL

1. Install in accordance with the manufacturer's instructions.
2. All sealing surfaces shall be smooth, clean and free of any form offsets.
3. Extend seal a minimum of 3 inches below the lowest adjustment riser.
4. Extend seal above the flange of the manhole frame.

J. COLD WEATHER CONSTRUCTION

1. Take all reasonable precautions to protect all parts of the Work from damage due to freezing or as a result of winter weather conditions.

K. BASIS OF PAYMENT

1. Standard manholes and standard drop manholes shall be measured and paid for at the contract unit price bid per each for STANDARD MANHOLE, TYPE __ and STANDARD DROP MANHOLE, TYPE __. This price shall be full compensation for the manhole base, risers, and cone; pipe connections; manhole joints; manhole flow channel and bench; manhole adjusting risers and rings; frame and cover; external frame seal; drop pipes; fittings and all labor, tools, equipment and incidentals necessary to install these items. Standard manholes and standard drop manholes shall also be measured from the lowest flow line to the top of cover and paid for at the contract unit price bid per vertical foot for STANDARD MANHOLE, TYPE V.F. and STANDARD DROP MANHOLE, TYPE V.F. This payment shall be full compensation for all manhole base, risers, and cone; pipe connections; manhole joints; manhole flow channel and bench; manhole adjusting risers and rings; frame and cover; external frame seal; drop pipes; fittings and all labor, materials, tools, equipment and incidentals necessary to complete each type of manhole in accordance with the Contract Documents.

22.08 WASTEWATER SERVICES/PRIVATE SEWERS

A. NEW CONSTRUCTION

1. Construction of new wastewater services not owned by the City shall conform to the construction requirements as provided in Title 24 of the Lincoln Municipal Code and the Lincoln Standard Plates.

B. RECONSTRUCTION

1. Reconstruction of wastewater services not owned by the City shall conform to the construction requirements as provided in Title 24 of the Lincoln Municipal Code and the Lincoln Standard Plates.

22.08 WASTEWATER SERVICES/PRIVATE SEWERS (Continued)

C. BASIS OF PAYMENT

1. WYE, ___" x___", shall be measured and paid for at the contract unit price bid per each for each size. This price shall be full compensation for all excavations, backfill, testing, labor, materials, tools, equipment and incidentals necessary to complete the Work in accordance with the Contract Documents.
2. Measurement and payment will be made at the contract unit price bid per each for CONSTRUCT or RECONSTRUCT SEWER SERVICE. Such payment shall be full compensation for all labor, tapping permits, plumbing permit, fittings, and materials, except as otherwise provided, excavation for taps and abandonments, backfill for taps and abandonments, sod, equipment, tools and incidentals necessary to complete the reconstruction in a workmanlike manner in accordance with the Contract Documents. Tapping saddles, taps, and plugs for abandonment will be supplied at no additional cost to the Contractor.
3. Measurement and payment will be made at the contract unit price bid per linear foot for SEWER SERVICE PIPE, ___". Such payment shall be full compensation for furnishing and installing all pipe materials, all labor, excavation, backfill, equipment, tools, collars or connecting devices, and incidentals necessary to place the pipe in service in accordance with the Contract Documents.

22.09 TESTING

A. GENERAL

1. Line acceptance testing is required for each section of sanitary sewer constructed between manholes or junction structures.
2. Manhole performance testing is required.
3. The tests specified herein shall not be initiated until the related backfill is compacted in place; the line, manholes, and structures have been cleaned of all interfering debris; and suitable access for necessary testing equipment is provided.
4. The Contractor shall furnish all labor, tools, and equipment to perform all the tests specified hereinafter and only in the presence of the City's Project Manager or observer, except where such tests are specifically designated as being the responsibility of the City.
5. The methods and the equipment used for the tests shall be in conformance with the ASTM standards.
6. The costs associated with the testing are to be considered subsidiary to the costs of the sewer lines and manholes.
7. Except for pipe replacement projects where existing services must be reconnected as the new replacement pipe is being laid, or as otherwise directed by the City's Project Manager, live wastewater flow shall not be permitted in the sanitary sewer line until all of the following tests are completed and found acceptable.

22.09 TESTING (Continued)

B. LINE ACCEPTANCE TESTING

1. Alignment Test:

- a. For straight section of sewer, an alignment test using either a lamp or a laser beam shall be performed. The light or laser beam shall be visible through the sewer between adjacent manholes.
- b. Repair or replace defective pipe or joints, or remove and relay pipe not meeting alignment tolerances.

2. Leakage Testing:

- a. Joint Testing for RCP in accordance with ASTM C1103 and C969.
- b. Low Pressure Air Testing for VCP in accordance with ASTM C828.
- c. Low Pressure Air Testing for CCFRPM, PVC and PP shall meet the minimum time allowance per ASTM F1417.

3. Television Inspection

- a. Contractor shall prepare the project site for safe entry and access.
- b. Internal television inspection of new sanitary sewers will be performed by the City at no cost to the Contractor.
- c. Television inspection will be scheduled no earlier than 30 days after the installation of the pipe and shall be done at the same time and in conjunction with final deflection testing and after all line leakage and manhole testing has been completed and found acceptable.
- d. Televised lines shall be termed 'acceptable' if no defects are found, such as open joints, breaks, cracks, excessive pipe deformation, intrusions, ground water infiltration, depositions and debris left in the line, sag in the line, or excessive vertical or horizontal misalignment.
- e. Follow-up TV inspection activities that may be required as a result of repairs to defective new sanitary sewers will be billed as an additional cost at the prevailing TV inspection rate.
- f. The prevailing TV inspection cost can be obtained from the Lincoln Transportation and Utilities Department Business Office.

4. Deflection Testing

- a. Perform deflection testing on all flexible pipe installed on the project.
 - (i) On any pipe size 8" to 15" the City will perform the deflection test, at no cost to the Contractor.
 - (ii) On any pipe size greater than 15", it will be the responsibility of the Contractor to perform the deflection test with City staff in observance.

22.09 TESTING (Continued)

C. LINE ACCEPTANCE TESTING

4. Deflection Testing (Continued)

- b. Final deflection testing shall be performed after the backfill has been in place at least 30 days.
- c. Pull deflection mandrel sized at 95% of the inside diameter of the pipe through the test segment using a pulling force equivalent to hand power.
- d. Ensure pipe deflection does not exceed 5% of average inside diameter as established by ASTM standards.
- e. The line shall be termed "acceptable" if, during final deflection testing, the mandrel passes completely through the line without restriction.
- f. In no case shall excessive force be applied in pulling the mandrel that may damage the pipe or that may erroneously indicate that deflection was within acceptable limits by temporarily expanding the pipe.
- g. Remove and replace pipe exceeding deflection limits at no additional cost to the City. No additional time waiting period shall apply for retesting following repair of the line and proper compaction of the backfill, unless otherwise directed by the City's Project Manager.
- h. Retest the line until found acceptable.

D. MANHOLE PERFORMANCE TESTING

1. General

- a. All manholes shall be constructed to be free from infiltration. The manhole shall also remain free from visible infiltration during the two-year period of guarantee.
- b. If any infiltration is observed during that period, the Contractor shall be required to make any necessary repairs.

2. Vacuum Testing

- a. Vacuum test manholes in accordance with ASTM C1244.

22.10 SUBSTANTIAL COMPLETION

Sanitary sewer work shall be considered substantially complete when all pipe is laid and backfilled; all manholes are complete and backfilled; all testing for all pipe and manholes is complete and accepted.

22.11 FINAL ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required Work is complete and accepted by the City's Project Manager, including internal television inspection, mandrel testing of all plastic pipe, all items on plan completed, and correction of all deficiencies found as a result of testing and/or final inspection by the City's Project Manager. Eligibility for final acceptance shall not be delayed for more than 60 calendar days past the date of substantial completion on account of the City's failure to complete internal television inspection and mandrel testing of plastic pipe because of equipment problems, scheduling conflicts, or other unforeseen circumstances attributable to the City's own responsibilities and actions.

22.12 GUARANTEE

At any time during the two-year guarantee period, and within the time period allowed, the Contractor shall correct any defect in material or workmanship which has been brought to his attention. Such items shall include but not be limited to trench settlement including subsequent pavement damage, pipe leaks, and failures.

22.13 ENVIRONMENTAL PROTECTION

Refer to Chapter 32 of these Standard Specifications for environmental protection during construction.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

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CHAPTER 23

WATER MAINS

23.00 GENERAL

The Work covered in this chapter includes the materials, appurtenant devices, water services, installation and testing of water main construction and reconstruction.

23.01 MATERIALS PURCHASED FROM THE CITY

The Contractor shall purchase the following materials from the Lincoln Water System:

- Valves
- Valve boxes, rings and lids
- Fire hydrants

The above materials are available for inspection at the Lincoln Water System Service Center. The Contractor shall provide all labor and transportation for loading and hauling of said materials.

Water will be supplied to the Contractor in conformance with the General Conditions and Title 17 of the Lincoln Municipal Code.

All materials shall be billed to the Contractor at prices and rates established by the Public Works and Utilities Business Office. Contractors may obtain the current material prices from the Public Works and Utilities Business Office.

23.02 CONSTRUCTION SERVICES PURCHASED FROM THE CITY

The Contractor shall purchase the following services from the Lincoln Water System:

- Flushing and disinfection services and materials
- Water main tapping and abandonments
- Water main shutdowns
- Installation of hydrant extensions

All services shall be billed to the Contractor at prices and rates established by the Public Works and Utilities Business Office.

23.03 CONTRACTOR SUPPLIED MATERIALS

A. REFERENCED STANDARDS

1. American National Standards Institute (ANSI). American Water Works Association (AWWA). Society of Cable Telecommunications Engineers (SCTE). All referenced standards shall be the latest revision thereof
 - a. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings
 - b. ANSI/AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems
 - c. ANSI/AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings
 - d. ANSI/AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

A. REFERENCED STANDARDS (Continued)

1. American National Standards Institute (ANSI) (Continued)

- e. ANSI/AWWA C115/A21.15 - Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
- f. ANSI/AWWA C151/A21.51 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast for Water
- g. ANSI/AWWA C153/A21.53 - Ductile-Iron Compact Fittings for Water Service
- h. ANSI/AWWA C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
- i. ANSI/AWWA C651 - Disinfecting Water Mains
- j. AWWA C800 – Underground Service Line Valves and Fittings
- k. ANSI/AWWA C900-16 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4" thru 60" for Water Transmission and Distribution
- l. AWWA C906-15 – Polyethylene (PE) Pressure Pipe and Fittings, 4" through 65"
- m. AWWA M28 – Rehabilitation of Water Mains
- n. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
- o. ANSI/SCTE 77 T15 – Specifications for Underground Enclosure Integrity

2. American Society for Testing and Materials (ASTM)

- a. A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- b. A380 – Standard Practice for Cleaning, Descaling and Passivating of Stainless Steel Parts, Equipment and Systems
- c. A536 – Standard Specification for Ductile Iron Castings
- d. A617 - Specifications for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.
- e. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings
- f. B88 - Specification for Seamless Copper Water Tube
- g. B584 – Standard Specification for Copper Alloy Sand Castings for General Applications
- h. D1248 – Specification for Plastic Molding and Extrusion Materials, Type 1, Class C, Grade 5
- i. F1216-09 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

A. REFERENCED STANDARDS (Continued)

2. American Society for Testing and Materials (ASTM) (Continued)
 - j. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joint Plastic Pipe
 - k. G97 – Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications
3. National Association of Corrosion Engineers (NACE)
 - a. NACE SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
 - b. NACE TM0497 – Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
4. Material and Construction Trade Standards
 - a. Ductile Iron Pipe Research Association, Polyethylene Encasement Installation Guide
 - b. Uni-Bell PVC Pipe Association, Installation Guide for PVC Pressure Pipe

B. JOINT TYPES

1. Push-on joints shall conform to the requirements of ANSI/AWWA C111/A21.11 for ductile iron pipe and “Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe ASTM F477 for Polyvinyl Chloride Pipe.”
2. Mechanical joints shall conform to the requirements of ANSI/AWWA C111/A21.11. Bolts and nuts for mechanical joints shall be high-strength, low alloy steel as described in Paragraph 11-6.5 of ANSI A21.11.
3. Restrained push-on joints shall conform to the performance requirements as described in Section 11.9 of ANSI A21.11.
4. Special mechanical joints shall conform to the following:
 - a. Swivel couplings (anchoring couplings) shall mean a standard plain end connection with an integrally cast compression gland and freely rotating bolt ring bearing on the compression gland, designed to mate with a standard mechanical joint connection and to prevent the joint from separating under pressure when all bolts are in place. Swivel couplings shall be similar to Tyler Pipe swivel adapter or U.S. Pipe rotatable mechanical joint gland. The rotatable bolt ring portion of swivel couplings shall be fabricated from ductile iron and shall have the letters “D.I.” or the words “Ductile Iron” cast in the bolt ring.
 - b. Solid couplings shall mean a standard plain end connection with an integrally cast compression gland and bolt ring, designed to mate with a standard MJ bell and gasket. Solid couplings shall be similar to Tyler Pipe solid gland or U.S. Pipe integral mechanical joint gland.

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

B. JOINT TYPES (Continued)

- c. All retainer glands shall utilize a wedge action principle or grip ring principle to fully restrain the fitting and pipe together. Wedge Action Retainer Glands shall be ductile iron with heat-treated ductile iron wedges and twist-off torque nut bolts. Ductile iron shall be per ASTM A536 grade 65-45-12. Wedges shall have a minimum hardness of 370 BHN. The gland shall allow for a minimum deflection of 3° and allow joint movement after installation. The gland shall be provided with torque limiting twist-off nuts with an additional fixed hex head to allow for removal and reinstallation of the gland. Twist-off torque nut bolts shall be coated or lubricated in a manner to prevent corrosion and premature twist-off of the torque limiting twist-off nuts. Additional requirements include:

TABLE 23.03 A – WEDGE REQUIREMENTS FOR RETAINER GLANDS

Specification Item	Ductile Iron Pipe	PVC Pipe
Pressure Rating For 6"-12" Pipe	350 psi	305 psi (DR 14)
Pressure Rating For 16" Pipe	350 psi	235 psi (DR 18)
Pressure Rating for 24" and larger	250 psi	NA
Color	Black	Red
Acceptable Manufacturers	EBAA Iron Megalug Series 1100 Ford Uni-Flange Series 1400 STAR Stargrip 3000 SIGMA One-Lok SLD TYLER UNION TUFGRIP	EBAA Iron Megalug Series 2000PV STAR PVC Stargrip 4000E9408985 TYLER UNION TUFGRIP PVC FORD Uni-Flange Series 1500

Acceptable manufacturers are required to meet all stated specifications requirements. Failure to meet requirements shall be cause for rejection.

- d. Mechanical Joint Restraint Adaptors for connection of MJ valves to MJ fittings and MJ fittings to MJ fittings shall be a bolt-through positive restraint mechanism meeting working pressure specifications of AWWA C153 for compact fittings and manufactured of ductile iron conforming to ASTM A536, 80-55-06. MJ adaptors shall connect standard mechanical joint fittings (AWWA C110 or C153) and valves at a linear distance not to exceed three (3) inches and without attachment to pipe. MJ adaptors shall be installed with standard styrene butadiene rubber (SBR) MJ gaskets conforming to the latest revision of AWWA C111 be supplied with an NSF 61, 7-mil. fusion bonded epoxy coating. The bolts and nuts shall be ASTM A193 Type 304 Stainless Steel. Acceptable manufacturer shall be Foster Adaptor.

5. Flange connections shall conform to the requirements of ANSI B16.1 for 125-pound class and shall also conform to ANSI/AWWA C115/A21.15. The flange gaskets shall be 1/8" thick red rubber. The gasket shall be of the full face or inside bolt ring coverage styles. Bolts shall be sufficient length to expose 1/4" to 1/2" of the bolt beyond the outer face of the nut when the joint is fully assembled.

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

B. JOINT TYPES (Continued)

6. Precast concrete cylinder pipe joints shall conform to AWWA C301. The joint rings shall be galvanized steel. The external joint filler material shall be cement impregnated polyurethane foam in a closed loop form equal to Mar Mac Flex-Protex or shall be a cement mortar grout composed of 1 part Portland or mortar cement to 2 parts sand and sufficient water to flow easily. Joint diapers shall be heavy-duty cotton with wire or steel straps in the hem. Diapers shall be a minimum of 6" wide for all pipes 36" in diameter or smaller. All diapers for pipes larger than 36" shall be a minimum of 7" wide.

C. GASKET MATERIAL

All gaskets, with the exception of gaskets for flanged joints, shall be neoprene or other synthetic rubber. Natural rubber gaskets are not acceptable.

D. JOINT LUBRICANTS

All joint lubricants shall be a vegetable soap base or equal and shall be supplied by the pipe manufacturer. Lubricants shall be supplied in sterile, tightly sealed, small quantity containers. Any lubricant which has been contaminated with dirt or other foreign material shall be rejected.

E. DUCTILE IRON PIPE

Ductile iron pipe shall conform to the requirements of ANSI/AWWA C151/A21.51. All pipe shall be Class 52 unless otherwise specified. The cement mortar lining shall be standard weight and shall conform to the requirements of ANSI/AWWA C104/A21.4. Unless otherwise specified, all pipe shall be supplied in 18' or 20' lengths and shall have push-on type joints.

F. PRESTRESSED CONCRETE CYLINDER PIPE

Prestressed concrete cylinder pipe shall be manufactured in conformance with AWWA C301 and shall be designed in conformance with Appendix A or Appendix B of that Specification. Pressures and external loads used in design shall be as specified elsewhere in the Contract Documents.

The Contractor shall supply the following information for approval prior to delivery of the pipe and appurtenances:

1. Design Calculations
2. Proof of Design Test Results
3. Tabulated Layout Schedule
4. Affidavit of Compliance

Fine aggregate shall be clean natural sand. Artificial or manufactured sand shall not be used.

All branch outlets and other connections shall be of the joint type shown on the plans. Where projects are terminated without connecting to existing pipe, a mechanical joint bell adapter and mechanical joint plug shall be provided.

Adapter section shall be provided to connect to valves, fittings and existing pipe. All adapters, fittings and other specials shall be cement mortar lined.

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

G. POLYVINYL CHLORIDE (PVC) PIPE

Polyvinyl Chloride (PVC) pipe shall conform to AWWA C900-16. All pipe 12" in diameter or smaller shall be PVC 1120 DR 14 with O.D. conforming to that of ductile iron pipe unless otherwise specified. PVC pipe larger than 12" in diameter shall be PVC 1120 DR 18 conforming to that of cast iron pipe unless otherwise specified. Joints shall be push-on type with rubber compression ring joints conforming to "Standard Specification for Elastomeric Seals (Gaskets) for Joint Plastic Pipe" ASTM F477.

H. HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

High-Density Polyethylene (HDPE) pipe may be used only upon review and approval of the Lincoln Water System. HDPE pipe shall conform to AWWA C906-15 and be a minimum Pressure Class DR11, Pipe Material Designation – PE 4710, with O.D. conforming to that of ductile iron pipe unless otherwise specified.

I. CURED-IN-PLACE PIPE (CIPP) LINING

Cured-in-place pipe (CIPP) lining may be used only upon review and approval of the Lincoln Water System. Liner material shall be a Class IV fully structural Cured-in-place pipe in accordance with AWWA M28, ASTM F1216-09, ASTM F1743-08 or ASTM F2019-03 with the exception that the liner thickness is in accordance with ASTM F1216-07a.

J. CAST IRON AND DUCTILE IRON FITTINGS

Cast iron and ductile iron fittings shall conform to the requirements of ANSI/AWWA C110/A21.10 and shall be supplied with a standard weight cement mortar lining conforming to ANSI/AWWA C104/A21.4 and all necessary glands, bolts, nuts and gaskets to complete a non-restrained mechanical joint fitting connection. Ductile iron compact fittings shall be in conformance with ANSI/AWWA C153/A21.53. All joints shall be mechanical joint bells unless otherwise provided in the Contract Documents.

Pressure ratings for fittings shall be a minimum of 250 p.s.i. water working pressure for 12" nominal diameter and smaller, based on the diameter of the largest bell. For fittings larger than 12" nominal diameter, a pressure rating of 150 p.s.i. shall be used unless otherwise specified.

K. ANCHORING COUPLINGS AND FITTINGS

Anchor couplings shall consist of a length of pipe with a solid coupling end connection and a swivel coupling end connection. Anchor couplings shall be similar to Tyler Pipe adapter swivel fittings or U.S. Pipe hydrant connection pieces.

Anchor elbows shall consist of 90° elbow with 2 swivel couplings, Anchor elbows shall be similar to the Tyler Pipe Swivel x Swivel 90° ELL swivel fittings.

Anchor pipe shall consist of a length of pipe with 2 swivel coupling end connections.

Swivel tees shall be cast to the requirements of ANSI A21.10 with mechanical joint run end connection and a swivel coupling on the branch connection. Swivel tees shall be similar to Tyler Pipe MJ x MJ x swivel tees or U.S. Pipe valve and hydrant tees.

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

L. RESTRAINT COLLARS FOR VALVES AND REDUCERS

Restraint collars for valves and reducers when using PVC for water main construction shall be supplied and constructed in conformance to the applicable Lincoln Standard Plans or contract Special Provisions. Restraint collars for valves and reducers shall be considered subsidiary to PVC Water Main construction and are not measured or paid for as a separate fitting for purposes of this chapter.

M. POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be Class C, black pigmented, 8 mils. thick, linear low density, polyethylene conforming to the requirements of ANSI/AWWA C105/A21.5. The encasement may be supplied in flat sheets or tubes at the Contractor's option. Tape used to repair or patch the encasement shall be manufactured from synthetic materials. Duct tape shall not be used for repairs. The tubes, measured when laid flat, and the flat sheets shall conform to TABLE 23.03 B – POLYETHYLENE ENCASEMENTS.

TABLE 23.03 B – POLYETHYLENE ENCASEMENTS

Nominal Pipe Diameter	Polyethylene Encasement Tube and Sheet Widths (inches)	
	Tube	Sheet
6"	20	40
8"	24	48
12"	30	60
16"	37	74
24"	54	108
30"	67	134
36"	81	162
48"	108	216
54"	121	242

N. COPPER SERVICE PIPE

Copper water service pipe shall be Type “K” seamless soft-drawn copper tubing which conforms to the “Specifications for Seamless Copper Water Tube”, ASTM Designation B 88.

O. SERVICE PIPE CONNECTORS

All copper service pipe connectors shall be fabricated from red brass. All copper supply and service pipe shall be joined by either flared-end connectors or brazed, non-lead, eutectic joints.

P. HYDRANT DRAIN MATERIAL

Hydrant drain material shall be clean, washed, hard, durable, uncoated and uniformly graded Class “A” gravel as specified by the Nebraska Department of Transportation. Gradation shall be as follows:

23.03 CONTRACTOR SUPPLIED MATERIALS (Continued)

P. HYDRANT DRAIN MATERIAL (Continued)

TABLE 23.03 C – HYDRANT DRAIN MATERIAL GRADATIONS

Sieve Size	% Passing	Tolerance
3/4"	100	0
3/8"	95	+/- 5
#4	78	+/- 4
#10	16	+/- 13
#200	3	+/- 3

Q. AIR RELIEF VALVES

Air relief valves shall be provided by the Contractor to conform to the size, type and configuration shown on the plans.

R. TRACER WIRE

All PVC water mains owned by the City of Lincoln shall be installed with a locator wire attached. The wire shall be direct bury 12 AWG solid steel core, copper clad wire with 30 mil, blue, HDPE insulator. Wire shall have a 30-volt rating with a minimum tensile break force of 380 pounds.

Approved manufacturer shall be Copperhead Industries, or equal. The wire shall be installed with as few splices as possible. Splices shall utilize end to end **3M DBR** connectors, sealed with silicone sealant, aqua seal, or equal and covered with Scotch #33 electrical tape.

23.04 REMOVED MATERIALS

A. GENERAL

When called for on the plans and Contract Documents, the Contractor shall remove water main pipe and dispose of it.

When called for on the plans, the Contractor shall remove and reset water main valves, hydrants, and plugs at the location and grade as indicated on the plans. The Contractor shall exercise care in the removal and resetting of these items. Removal and Resetting of hydrants and valves will only be allowed in cases where the existing item was installed within the past 5 years, otherwise they shall be Removed and Salvaged. The Contractor shall thoroughly examine each appurtenance to ascertain whether it is in proper working condition; and if there is a question regarding the condition of the appurtenance, the Contractor shall contact the Lincoln Water System to exchange the item for one that is working.

When called for on the plans and Contract Documents, water main valves, hydrants, and plugs shall be removed and salvaged. The Contractor shall deliver the salvaged appurtenances to the Lincoln Water System Shop. Receipts for salvaged materials shall be delivered to the City's Project Manager.

B. BASIS OF PAYMENT

Water main pipe removed in conformance with these Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per linear foot for REMOVE WATER MAIN. Such payment shall be full compensation for all excavation, removal, backfill, disposal of excess materials, equipment, tools, labor and incidentals necessary to perform the Work called for.

Water main valves, hydrants and plugs removed and relayed, removed and salvaged, or removed in conformance with these Specifications and accepted by the City's Project Manager shall be measured and paid for at the contract unit price bid per each for REMOVE AND SALVAGE _____, REMOVE AND RESET _____, or REMOVE _____. Such payment shall be full compensation for all excavation, removal of appurtenances and thrust blocking, bedding or foundation rock if required, resetting, loading of salvaged items, resetting valve box, backfill, materials, equipment, tools, labor and incidentals necessary to perform the Work.

23.05 HANDLING AND STORAGE

The Contractor shall protect all material from damage and handle material carefully in conformance with the manufacturer's recommendations. Equipment used to handle material such as slings, lifting lugs, hooks and other devices shall be designed to protect pipe, coatings, linings, joint elements, castings, valves, hydrants, and all other material.

Gaskets shall be protected from deterioration and stored out of direct sunlight for prolonged periods and in such a manner that they will not contact oils, fumes, solvents, and other materials and substances that attack rubber or synthetic rubber materials.

All hydrants and valves shall be protected so that latent water within the valves or hydrants will not freeze. The hydrants and valves shall be stored in such a manner that water will not enter drains and other openings. All butterfly valves shall be stored indoors. All resilient seated wedge valves shall be stored indoors or with the wedge in a raised position. All pipe, fittings, valves and hydrants shall be kept clean and protected from contamination by mud and dirt.

23.05 HANDLING AND STORAGE (Continued)

Prestressed concrete cylinder pipe shall not be stacked higher than allowed by the manufacturer's recommendations. PVC pipe shall not be stacked higher than 8' or in conformance with manufacturer's recommendations whichever is less. Ductile iron pipe shall not be stacked higher than allowed in TABLE 23.05 A – DUCTILE IRON PIPE STORAGE.

TABLE 23.05 A – DUCTILE IRON PIPE STORAGE

Pipe Size	Maximum Number of Tiers
6"	13
8"	11
12"	9
16"	7
24"	5
30"	4
36"	4

No direct measurement or payment for storage and handling of materials used in the construction of water mains will be made. The costs associated with the materials to be incorporated into the Work shall be considered subsidiary to the items for which direct payment is made.

23.06 EXCAVATION AND BACKFILL

Excavation and backfill for water mains and appurtenances shall conform to the requirements of Chapter 20 of these Specifications except as hereinafter modified for water main construction. Unless otherwise shown on the plans, modified by Special Provisions, or directed by the City's Project Manager, all PVC pipe shall be embedded with approved materials to at least 6" above the top of the pipe.

23.07 INSTALLATION OF PIPE AND FITTINGS

A. GENERAL

The Contractor shall use the proper tools and equipment necessary to safely install all pipe, fittings and appurtenances to the lines and grades as shown on the plans. Installation of pipe and fittings shall be in conformance to manufacturer's requirements and instructions except where otherwise provided in the specifications. Prior to beginning Work, the Contractor shall submit to the City's Project Manager a copy of the manufacturer's installation instructions for review and approval. The Contractor shall retain a copy of the installation instruction at the project site for reference during construction. PVC pipe shall be installed in strict conformance to the manufacturer's requirements and instruction except that in no case shall PVC pipe be installed by bending the pipe.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

B. CUTTING PIPE

1. Ductile Iron Pipe

When nonstandard lengths of pipe are required to install valve and fittings, terminate lines, or make connections, the Contractor shall cut the pipe using an abrasive wheel, milling type cutter, or other approved mechanical cutter. Torch cutting shall be used only with specific permission of the City's Project Manager and then only in strict conformance with the manufacturer's recommendations. After cutting, the Contractor shall bevel the ends of the pipe to approximate the manufactured bevel of a full length of pipe. Pipe which is not cut square or which has rough and jagged edges that might nick or cut gaskets shall be reworked to the approval of the City's Project Manager.

2. Prestressed Concrete Cylinder Pipe

No cutting of prestressed cylinder pipe will be allowed. All pipe which does not fit or close shall be rejected and the rejected pipe removed from the job site.

3. PVC Pipe

PVC pipe shall be cut using carpenter, hack saws or abrasive wheel. Care shall be taken to make all cuts square and perpendicular to the longitudinal axis of the pipe. After cutting, the Contractor shall bevel the ends of the pipe to approximate the manufactured bevel of a full length of pipe. Pipe which is not cut square or which has rough and jagged edges that might nick or cut gaskets shall be reworked to the approval of the City's Project Manager. When 12" butterfly valves are called for on the plans for PVC pipe, the pipe ends shall be chamfered on the inside radius as detailed in the Lincoln Standard Plans so that the valve operates to a fully closed position.

C. PREVENTING CONTAMINATION

Existing valves and valves connecting the existing system to the new construction shall be operated only by the Lincoln Water System; except that the Contractor may operate those valves to fill the new mains for testing, only after notification of Lincoln Water System personnel.

The Contractor shall keep the pipe and appurtenances clean and free from tools, rags, dirt, mud, non-potable water, and other foreign materials and objects at all times during installation. If pipe laying is stopped or delayed for any reason, the Contractor shall seal the open ends of all pipes. Seals shall be capable of preventing the entry of water and other foreign material with the excavation completely full of water.

All pipes shall be jointed immediately after placement in the excavation. Bell-ends of pipe shall face in the direction of laying. The Contractor shall ensure that the pipe is not displaced after it is laid to the proper line and grade; and should the pipe become displaced the Contractor shall relay the pipe to the proper line and grade at no additional cost or expense to the City.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

D. UTILITY CONFLICTS

Where unforeseen conflicts between the water construction and existing utilities are discovered, the Contractor shall immediately notify the City's Project Manager. Where the water main is to be constructed below or within 18" of a storm sewer pipe, the Contractor shall lay a full length of water main pipe centered on the sewer or such length as will provide the maximum possible separation of the joints in the water main from the sewer line. The Contractor shall also reconstruct any sanitary sewer with (1) 20' length of C900 pressure pipe or equivalent, such that the maximum possible separation between the water main and the sewer pipe joints will result. The backfill material shall be select, low-permeability soil.

Where the water main is located below a sanitary sewer pipe, to prevent the possibility of contaminated wastewater reaching the potable water main, the entire space between the top of the water main up to the spring line (half way) of the sanitary sewer shall be back-filled with flowable fill. No granular fill shall be used. The extent along the water main shall be the entire length of pipe and fittings at the bottom of the excavation, and the extent along the sewer shall be to undisturbed earth. This flowable backfill shall be subsidiary to other items of work for which direct payment is made.

Where existing water mains are to be looped around another utility, the Contractor shall plan his Work so that disruptions to water service are minimized. The Contractor shall provide adequate personnel, equipment and materials necessary to complete the Work as quickly as possible. All necessary materials shall be on site, and where ever possible, the Contractor shall preassemble the entire looping configuration, including bends or offsets and restraint devices, before the water main will be scheduled for shutdown by Lincoln Water System. Service fees charged by the Lincoln Water System shall be considered subsidiary to the cost of looping the water main in the event of a utility conflict. Additional fees for extended shutdowns shall not be cause for additional compensation to the Contractor.

E. CAST-IN-PLACE THRUST RESTRAINTS

The Contractor shall construct concrete thrust blocks conforming to the requirements of the Lincoln Standard Plans at all locations shown on the plans or indicated by the City's Project Manager. All thrust blocks shall be placed so that pipe and fitting joints will be accessible for repairs. The bearing face of all thrust blocks shall rest against undisturbed soil.

When the existing water mains must be reconstructed or looped, the Contractor shall restrain all fittings with ductile iron retainer glands installed in conformance with the manufacturer's recommendations in addition to concrete thrust blocks, anchorages and/or gravity blocks.

Gravity block straps of the size and type specified in the Lincoln Standard Plans shall be State Steel type M1020, or equivalent, low carbon, low manganese, general purpose, merchant quality stainless steel that is suitable for forming and welding. All strap material not embedded in concrete shall be covered with polywrap or tape prior to backfilling.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

F. TRACER WIRE

The Contractor shall install tracer wire (as per 23.03 P) directly to the top of the pipe between the 10 o'clock and 2 o'clock positions, with PVC pipe only. Tracer wire shall be secured to the main every 5' with tape patches and shall be secured so that some slack can be taken out of the wire for valve and tap installations. Tracer wire shall be extended to the ground surface and terminated in conformance with the Standard Plans using a coil of excess wire at least 18" in length inside the valve box. For line valves and hydrant branch valves (branch less than 10') the tracer wire shall be attached to the exterior of the valve box and inserted into the valve box 8" from the top of the box through a field drilled 1/2" hole. Tracer wire shall be installed with as few splices as possible. No bare wire shall be exposed, with the exception of 1" of wire to be stripped at the access loop for contact with tracing equipment. The two ends of the wire shall be knotted to prevent strain on the splice. Branch connections shall be made without cutting the main wire utilizing a connection clip and sealing the joint the same as splices. Tracer wires shall be tested by the Contractor for continuity after backfilling with a wire continuity tracing device. All wires failing to provide positive continuity for signal transmission shall be repaired or replaced at the Contractor's expense. After testing the ends, all tracer wires shall be sealed with heat shrink tape. Installation and testing of tracer wire shall be considered subsidiary to the installation of PVC pipe.

All water main reconstructions (loops for conflicting utilities) as shown on LSP 301 shall have tracer installed when using PVC pipe. When reconstruction is performed on ductile iron pipe or cast-iron pipe, tracer wire shall be terminated on both ends of the loop directly to the existing pipe using an exothermic welded connection, or a stainless steel Cathodi-Clamp™. Polyethylene encasement shall be (re)installed over the areas of the existing pipe where the tracer is terminated extending from a minimum of 2' past the connection point of the new PVC pipe to a minimum of 2' past the wire termination point on the existing water main.

G. JOINTING PIPES

1. General

All bells, gaskets, lubricants and appurtenances shall be kept clean. Gaskets shall be of the proper style for the pipe being laid. Joints shall be deflected after assembly.

2. Ductile Iron Pipe

Bell ends shall be protected during joining by approved methods.

Maximum pipe joint deflections for push-on and mechanical jointed pipe shall conform to TABLE 23.07 A – MAXIMUM JOINT DEFLECTIONS.

3. PVC Pipe

PVC pipe shall be joined by inserting the spigot end of the pipe into the bell no further than marked by the manufacturer. Insertion on the PVC pipe further than the manufacturer's mark shall require reassembly. Bell ends shall be protected during joining by approved methods. Maximum pipe joint deflections for PVC pipe shall conform to the manufacturers recommended standards for the brand of pipe being installed.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

G. JOINTING PIPES (Continued)

4. Mechanical Joints

Mechanical joints shall be assembled in strict conformance with the manufacturer's instructions and recommendations. Bolts on opposite sides of the joint shall be drawn up evenly to ensure even pressure around the gland and gasket. The Contractor shall tighten all retainer gland screw wedges according to manufacturer's recommendations for each type of retainer gland and pipe material. Prior to final tightening, the Contractor shall make any necessary deflections. Deflections for DUCTILE IRON pipe shall not exceed those shown in TABLE 23.07 A – MAXIMUM JOINT DEFLECTIONS.

TABLE 23.07 A – MAXIMUM JOINT DEFLECTIONS (DUCTILE IRON PIPE ONLY)

Pipe Diameter	Push-on Joints			Mechanical Joints		
	Deflection Angle	Maximum Offset	Minimum Curve Radius	Deflection Angle	Maximum Offset	Minimum Curve Radius
6"	4° 00'	17.0"	285'	4° 00'	17.0"	285'
8"	4° 00'	17.0"	285'	4° 00'	17.0"	285'
12"	4° 00'	9.5"	285'	4° 00'	9.5"	285'
16"	2° 24'	9.5"	475'	2° 24'	9.5"	475'
24"	2° 24'	9.5"	475'	2° 24'	9.5"	475'
30"	2° 24'	9.5"	475'	2° 24'	9.5"	475'
36"	2° 24'	9.5"	475'	2° 24'	9.5"	475'
48"	1° 36'	6.5"	715'	1° 36'	6.5"	715'
54"	1° 12'	5.0"	955'	1° 12'	5.0"	955'

5. Prestressed Concrete Cylinder Pipe Joints

The Contractor shall make all joints in prestressed concrete cylinder pipe in strict conformance with the manufacturer's instructions and recommendations. After placing the gasket on the spigot end of the pipe, the Contractor shall run a smooth round steel rod between the gasket and the spigot for one complete turn around the pipe and repeat in the opposite direction to ensure uniform stretching of the gasket.

After seating but prior to homing the pipe, the Contractor shall check the gasket for proper location using feeler gauges. Gaskets for pipes larger than 24" in diameter shall be checked from both the inside and outside of the pipe. Pipes shall be deflected where required after homing, according to the following:

TABLE 23.07 B – MAXIMUM JOINT OPENINGS

Pipe Diameter	Maximum Joint Opening
6"-36"	3/4"
48"	1'
54"	1'-1/8"

The exterior joint recesses shall be filled with cement mortar. Cement mortar shall be rodded into diaphragm with a wire curved to conform to the radius of the pipe.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

H. POLYETHYLENE ENCASEMENT

Polyethylene (PE) encasement shall be installed on all ductile and cast-iron water mains, water valves, fittings and water services using Method A or B as detailed in AWWA/ANSI C105/A21.5 except that the encasement shall consist of double wrapping. All pipe and fittings encased with PE shall be handled, repaired and installed in conformance to guidelines published by DIPRA. The Contractor shall double wrap and seal with tape all bolted connections, anchoring couplings, anchoring elbows, valves, and fire hydrants. Encasement for fittings and valves on PVC pipe shall extend a minimum of 18" past the joint. The Contractor shall ensure that hydrant drain holes are not blocked or covered. All water main and service valves shall be doubled wrapped, fully encased and sealed with tape around the valve stem operator underneath the operating nut.

The Contractor shall wrap all copper supply pipes from the tap extending 5' away from any ductile or cast iron main, and shall repair all PE encasement at the tap location. Copper services connected to PVC water mains are not required to be encased, unless otherwise noted. All ductile iron fittings used on PVC water services shall be doubled wrapped.

I. WATER MAIN SHUTDOWNS

The Lincoln Water System schedules and performs all shutdowns of the existing water system and corresponding interruptions of service to customers. Unless otherwise approved by the Engineer, the Contractor shall excavate areas of work prior to LWS scheduling shutdowns with customers to better assess the time required for the service interruption. In all cases the Contractor shall provide at least 48-hour notification for a request to interrupt service.

The Lincoln Water System also schedules and performs tapping, valve operation, and flushing and disinfection services, when required. In all cases the Contractor shall notify the Assistant Superintendent of Water Construction, or his representative, to provide for scheduling such services at least 48 hours prior to the time that they are needed. These services shall be scheduled only during City working hours.

Prior to LWS making the shutdown, the Contractor shall be fully prepared to perform the work in the most expedient manner possible. The Contractor shall have all necessary fittings, pipe, tools, and accessories available onsite and all parts/pieces necessary to complete the work must be preassembled to the extent possible to perform the work. If in the opinion of LWS, the City's Project Manager or the Engineer that the contractor is not fully prepared to perform the work, a shutdown shall not be provided. The LWS reserves the right to charge the contractor a lump sum amount not to exceed \$200 if the shutdown is cancelled due to lack of preparedness. This condition shall be not cause for claim of damages or additional compensation by the Contractor.

If the proposed work involves 8" or larger water mains, any fittings to complete the installation or affects service to commercial or industrial customers, then a plan must be submitted to LWS for approval. The aforementioned plan shall indicate all fittings and dimensions of any pieces to be installed to complete the work causing the shutdown. The plan shall indicate the estimated time out of service, requested time for the shutdown, general description of how the work will be performed, required pumping equipment and the number of employees expected to perform the work.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

I. WATER MAIN SHUTDOWNS (Continued)

The water main shall be excavated prior to the shutdown and the excavation prepared to make work conditions safe and clean. Where directed by LWS, the City's Project Manager or the Engineer, the contractor shall use approved bedding material in the bottom of the excavation to provide a suitable work surface for ease of construction and to provide for sanitary conditions. These materials shall be compensated in accordance to applicable bid items.

Contractors shall be adequately equipped to pump drain water and anticipate some leakage of water past valves. Adequate pumping equipment shall be a condition for approval of the shut-down plan.

There shall be no cost for a shut-down which interrupts water service for less than two (2) hours. For interruptions of water service lasting two (2) or more hours, the shut-down fees are as follows:

TABLE 23.07 C - WATER MAIN SHUTDOWN APPLICABLE FEE SCHEDULE

Hours of Shutdown	Applicable Fee
0 – 2 hours	no charge
2 – 3 hours	\$200
3 – 4 hours	\$700
4 – 5 hours	\$1,700
5 – 6 hours	\$4,200
6 – 7 hours	\$9,200
7 – 8 hours	\$19,200
over 8 hours to 12 hours	\$15,000 each additional hour
over 12 hours	\$25,000 each additional hour

Example: Fee for water main shut down for 11.5 hours =
 $\$19,200 + \$15,000 + \$15,000 + \$15,000 + \$15,000 = \$79,200$

The shut down time shall be considered the time from when the water main has been isolated by the Lincoln Water System (LWS) to the extent possible up to the time that LWS is notified that work has been completed sufficiently to allow service to be restored. This cost shall not be reimbursable.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

J. BASIS OF PAYMENT

WATER MAIN of the various sizes called for on the plans shall be measured and paid for at the contract unit price bid per linear foot for each different diameter required. Pipe shall be measured through fittings and valves. Such payment shall be full compensation for all excavation, backfill, pipe, bedding material, other materials, testing, equipment, tools, labor, and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

DUCTILE IRON PIPE WATER MAIN of the various types and sizes called for on the plans shall be measured and paid for at the contract unit price bid per linear foot for each different diameter required. Pipe shall be measured through fittings and valves. Such payment shall be full compensation for all excavation, backfill, pipe, other materials, testing, equipment, tools, labor and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

POLYVINYL CHLORIDE (PVC) WATER MAIN of the various types and sizes called for on the plans shall be measured and paid for at the contract unit price bid per linear foot for each different diameter required. Pipe shall be measured through fittings and valves. Such payment shall be full compensation for all excavation, backfill, pipe, bedding material, other materials, testing, equipment, tools, labor, and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

All CAST IRON AND DUCTILE WATER MAIN FITTINGS, including ductile iron compact fittings, shall be measured separately and shall be paid for at the contract unit price bid per each for the various fittings called for in the proposal.

Glands, bolts, nuts and gaskets necessary to complete a non-restrained mechanical joint connection for water main fittings are considered accessory items to the connection. No direct payment shall be made for these items, but are considered subsidiary to CAST IRON AND DUCTILE IRON WATER MAIN FITTINGS for which payment is made.

RETAINER GLANDS of the various sizes called for to complete a restrained mechanical joint connection for water main fittings shall be counted and paid for at the contract unit price bid per each. All Work shall be in conformance with these Specifications and accepted by the City's Project Manager.

23.08 INSTALLATION OF VALVES AND HYDRANTS

A. GENERAL

Immediately prior to installation, the Contractor shall inspect all valves and hydrants to ensure they are in good operating condition and free from defects. All valves shall be installed in such a manner that the operating nut and key will be in a vertical position. When the operator is located on the side of the valve, the Contractor shall install the valve with the operator located on the curb side of the valve.

All valve sizes should rest on support block with treated wood wedge(s) driven between the bottom of the valve and the support blocking. Valves 12" in diameter and larger shall be installed resting on one or more precast concrete support blocks 18" square and 4" thick which bear against undisturbed earth.

23.08 INSTALLATION OF VALVES AND HYDRANTS (Continued)

A. GENERAL (Continued)

The Contractor shall check the installation of all butterfly valves to be certain that the valve can be operated throughout its entire range of operation, and that it does not have contact with the inside edges of the pipe when operating.

Where tapping sleeves and valves are to be installed, the Contractor shall make all excavations to the dimensions required and provide all necessary trench protection. The Contractor shall provide precast concrete pads and other stabilizing materials under the tapping valves necessary to prevent rotation of the tapping sleeve on the main.

The Contractor shall provide and install a valve box over every valve operator. The valve box shall be installed plumb and centered over the operating nut and with the bottom of the box sufficiently lower than the operating nut to prevent the entry of soil. The top of the box shall be set flush with the final grade or paved surface. Valve box adjusting rings shall not be used to adjust valve boxes to grade. Valve boxes shall be stabilized to prevent out of alignment during compaction. Misaligned valve boxes shall be replaced during the warranty period.

Hydrants shall be set plumb, resting on precast concrete pads, 4" thick and 16" square. The support pads shall rest against undisturbed earth. The top of the flange on the hydrant shall be set to the grade shown on the plans. A hydrant of the length shown on the plans shall be used to attain this elevation. The Contractor shall make appropriate deflections or rotations in the tee and anchoring elbow, or use an anchoring offset, to meet this grade.

Fire hydrant barrel lengths shown on the plans are estimated and may not be sufficient dimensions for actual field conditions due to conflicting utilities and field modifications of water main profile. Contractors shall confirm actual hydrant barrel length required prior to construction so that hydrants are constructed in accordance to the LSP. This work shall be subsidiary to the water main construction.

Where a hydrant extension is necessary to meet the required grade, the hydrant extension shall be installed only by Lincoln Water System. Only one extension will be permitted on a hydrant. The Contractor shall remove and reset all hydrants which cannot be adjusted to grade with one extension. The Contractor shall notify the City's Project Manager or that person's representative when hydrant extensions are required.

The Contractor shall place a minimum of 0.75 cubic yards of hydrant drain material (as per 23.03 N) around the base of the hydrant to allow free ready drainage of the barrel. Polyethylene wrap shall be placed on top of the drainage gravel prior to the commencement of backfilling. Hydrant drain holes shall be kept open and clean at all times. Care should be exercised as to not block the drain holes with polyethylene wrap or concrete from backing blocks.

When obtaining hydrants from the Lincoln Water System, the Contractor shall determine and select the hydrant shoe configuration that best suits proper orientation of the steamer (large) nozzle perpendicular to the curb line. When required, adjustments to the final hydrant nozzle orientation shall be made by the Lincoln Water System with all applicable costs and fees assessed to the Contractor. These fees shall be considered subsidiary to the cost of installing the water main and shall not be cause for additional compensation by the Contractor.

Backfill shall be accomplished in conformance with the provisions of Chapter 20 of these Specifications, except that all backfill within 3' of all hydrants and valve boxes shall be compacted using a mechanical hand tamper to 96% of maximum dry density as measured by AASHTO Method T-99.

23.08 INSTALLATION OF VALVES AND HYDRANTS (Continued)

B. BASIS OF PAYMENT

All VALVES of the various types and sizes indicated on the plans and actually installed shall be counted and paid for at the contract unit price bid per each. Such price shall include the valve, valve box, support blocks, other materials and labor necessary to install the valves, all equipment, tools, and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

All HYDRANTS installed, as shown on the plans or as directed, except temporary hydrants used for flushing or disinfection of the mains, shall be counted and paid for at the contract unit price bid per each for HYDRANT, COMPLETE, L=5.5' or L=6.5'. Such price shall be full compensation for all loading, hauling, installation, thrust blocking, hydrant drain material, backfilling, labor, tools, materials, equipment and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

All HYDRANT EXTENSIONS necessary to adjust the hydrants to grade shall be counted and paid for at the contract unit price bid per each for HYDRANT EXTENSION, COMPLETE. Such price shall be full compensation for all installation costs charged by Lincoln Water System, hydrant extension kits, labor, tools, materials, equipment and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

The unit price for HYDRANT EXTENSION, COMPLETE shall be an established unit price per each in the bid proposal.

23.09 BENTOMAT® CL GEOSYNTHETIC CLAY LINER

A. GENERAL

This work shall consist of installation of Bentomat® CL Geosynthetic clay liner (GCL) on water pipe as specified on the plans.

B. MATERIAL

GCL shall be Bentomat® CL Geosynthetic clay liner (GCL) as manufactured by CETCO and dry Bentonite granules shall be non-toxic, high swelling, low dust, granular, sodium bentonite used for sealing overlapped sections of geosynthetic clay liner around pipe. Acceptable brands are CETCO Volclay CG-50 (50 lb. bag) and BAROID granular bentonite (50 lb. bag) available at local horizontal directional drilling (HDD) supply companies.

C. INDICATIONS FOR USE

As specified on drawings, in Contract Specifications or as directed by the Engineer, GCL shall be installed in accordance with this Construction Standard on all water pipe in locations where it is impractical or unfeasible to obtain the required separation between the water main and existing or proposed sanitary or storm sewers per State of Nebraska Department of Health and Human Services Title 179 NAC 7.

The GCL shall be installed 360° around polyethylene encased pipe to create a second barrier between the pipe and the surrounding soil. For pipe that normally is not encased in polyethylene wrap (i.e. PVC, HDPE, etc), install one layer of polyethylene wrap prior to installing the GCL. All lumps of clay, mud, and so forth, on the pipe surface shall be removed prior to installation of the polyethylene encasement and GCL.

23.09 BENTOMAT® CL GEOSYNTHETIC CLAY LINER (Continued)

C. INDICATIONS FOR USE (Continued)

During installation, care shall be taken to prevent soil from becoming trapped between the polyethylene encased pipe and GCL.

The GCL shall be installed in a manner to provide a snug fit. Extra care shall be taken to completely cover and bridge irregular surfaces such as bell-spigot interfaces, bolted connections, and fittings. The GCL shall not be installed in locations where the surrounding soil is contaminated.

D. EQUIPMENT

Additional equipment needed for installation of GCL's includes:

- Sharp Gasket Knife and spare blades
- Bentonite mastic and/or granular Bentonite paste made from dry powder sodium Bentonite
- Adhesive tape

Cutting GCL shall be performed using a sharp gasket knife. Frequent blade changes are recommended to avoid tearing of the geotextile components of the GCL.

The GCL shall be sealed around pipe joints, MJ hubs, flanges, bolts, nuts, valve bonnets, actuators, etc. using tape and bentonite past or bentonite mastic to seal GCL to these irregular surfaces.

E. BENTONITE PASTE PREPARATION

Bentonite paste shall be prepared immediately prior to installation of the GCL. Mix water with bentonite granules to form a paste with a consistency similar to peanut butter. Spread bentonite past on seams and folds before taping. If desired, bentonite paste may be spread with a trowel on polyethylene-wrapped pipe and fittings before wrapping with GCL.

F. INSTALLATION ON PIPE

The standard 15' wide roll of GCL is similar to heavy carpeting for handling purposes. Unroll the 15' roll of GCL and cut off the required amount needed to wrap around the outside diameter plus the required seam overlap on the bell end of MJ or RJ pipe. Refer to Table 23.09A below for the amount to cut from the roll.

TABLE 23.09 A – BENTOMAT GCL INSTALLATION GUIDE

PIPE SIZE	OD MJ/RJ BELL	CIRCUMFERENCE OF MJ/RJ BELL	MINIMUM SEAM	FEET TO CUT
			OVERLAP ON MJ/RJ BELL	FROM 15' WIDE ROLL
6"	11.44"	35.94"	6"	4'
8"	13.97"	43.89"	6"	4'
12"	18.75"	58.90"	6"	6'
16"	23.22"	72.95"	6"	7'
24"	32.54"	102.23"	9"	10'

The GCL shall be wrapped around the pipe for the full length of the piping section, as indicated on project drawings or as directed by the Engineer, plus 2 additional feet. Therefore, if the section of pipe is longer than 13', additional sections of GCL shall be cut off of the roll and installed on the pipe in an overlapped fashion until the required length of pipe plus the additional 1' on each end has been wrapped.

23.09 BENTOMAT® CL GEOSYNTHETIC CLAY LINER (Continued)

F. INSTALLATION ON PIPE (Continued)

For example:

If a section of 12" diameter pipe to be covered with GCL is 20' long, two 6' long sections would be cut off the 15' wide GCL roll. These sections would be trimmed and overlapped a minimum of 1' in the middle and 1' on each end of the pipe section for a total distance of 22', see Figure 1 and Figure 2. Seal the area where the two sections of GCL overlap with Bentonite paste and tape closed.

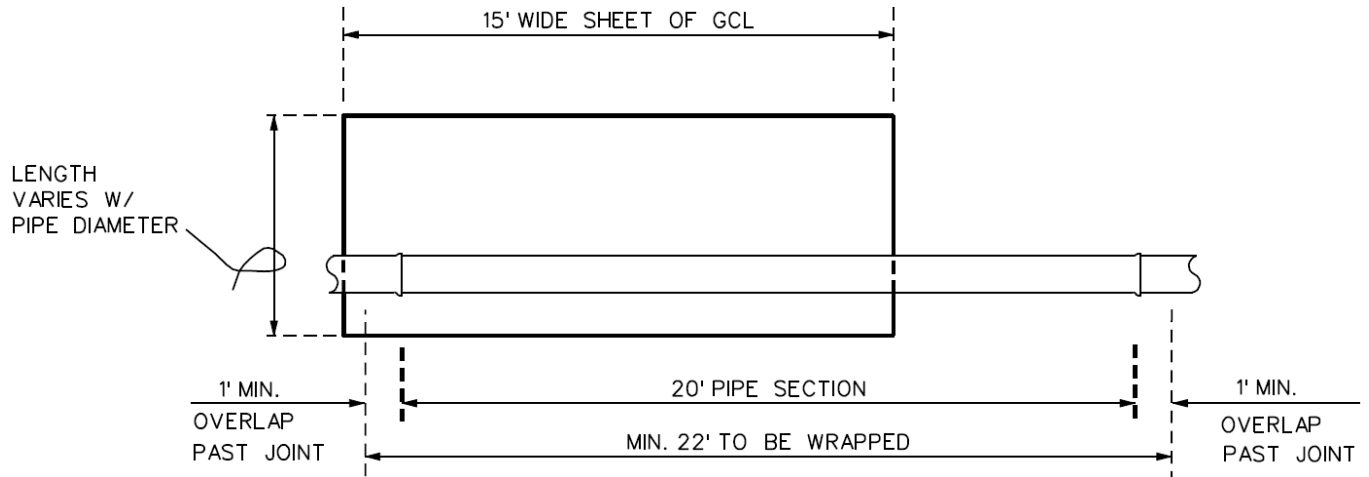


FIGURE 1

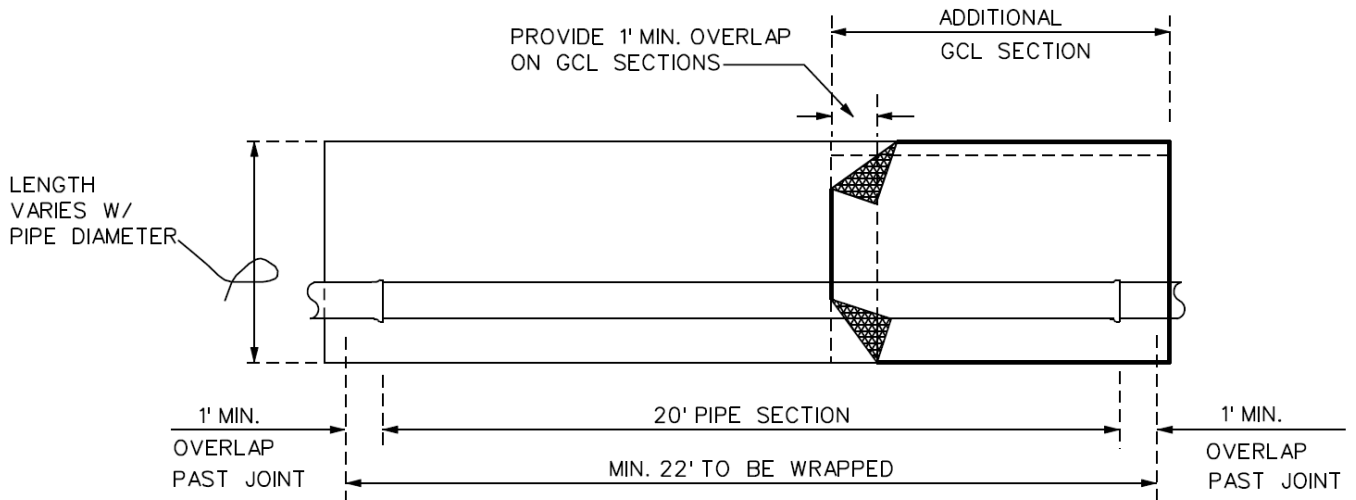


FIGURE 2

23.09 BENTOMAT® CL GEOSYNTHETIC CLAY LINER (Continued)

F. INSTALLATION ON PIPE (Continued)

Bring the sections of GCL up and around the circumference of the pipe overlapping the bell, barrel and spigot with a minimum of 6" to 9" as specified in Table 1. Take up the slack width at the top of the pipe as shown in Figure 3 to make a snug but not tight fit along the barrel of the pipe and/or surface of fitting, securing any folds in the GCL with tape. Folds shall be made, pasted and taped closed such that open area of fold does not collect back-fill material. Spread bentonite paste over folds and seams to seal wrap as needed prior to backfilling.

After folds and seams have been pasted and taped closed along the longitude of the pipe section the ends shall be pasted with bentonite and sealed with tape as shown in Figure 4.

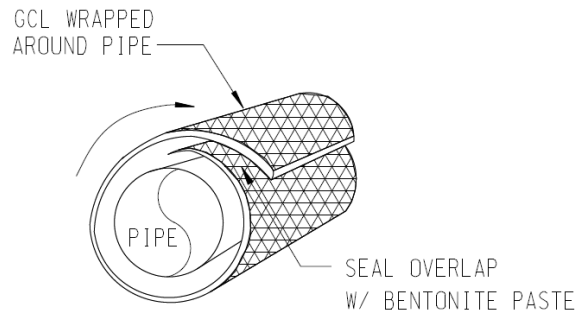


FIGURE 3

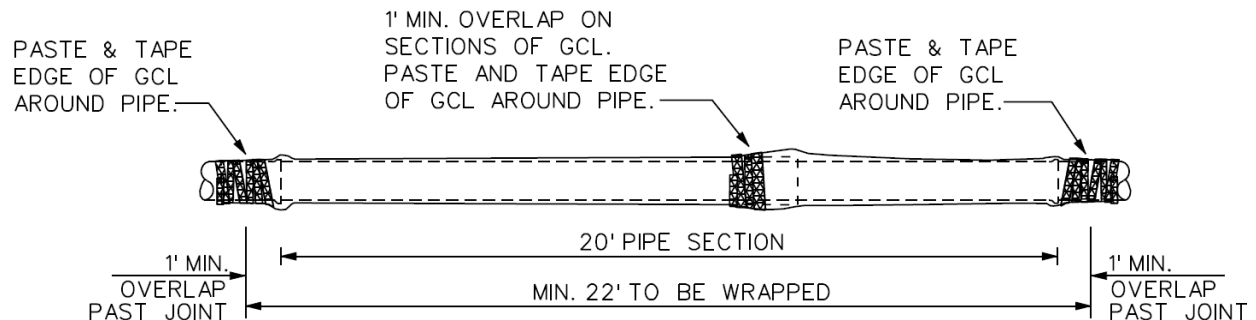


FIGURE 4

23.09 BENTOMAT® CL GEOSYNTHETIC CLAY LINER (Continued)

G. INSTALLATION AT SEWER CROSSING

Bentomat® encasement at sewer crossing shall extend a minimum of 10' beyond the outside edges of single sewers. At locations where multiple sewers are crossed, the encasement shall extend 10' from the outside edge of the first sewer crossing to 10' beyond the outside edge of the last sewer crossing. See Figure 4A.

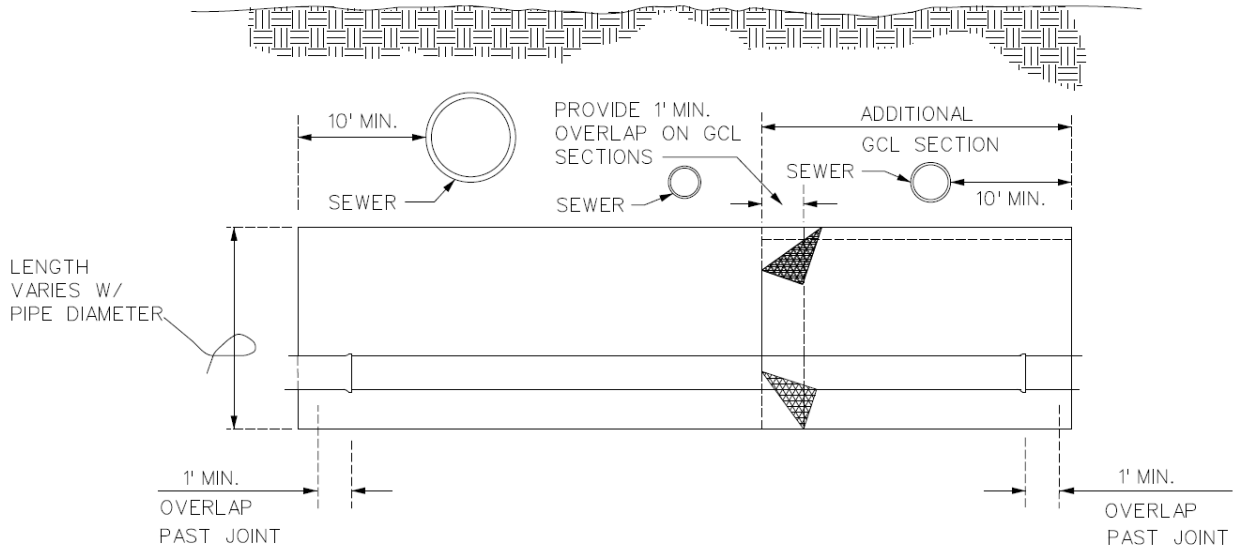


FIGURE 4A

H. BASIS OF PAYMENT

Bentomat® CL Geosynthetic clay liner (GCL) installed per this Chapter, as shown on the plans or as directed, shall be paid for at the contract unit price bid per Square Foot for BENTOMAT GEOSYNTHETIC CLAY LINING. Such price shall be full compensation for all loading and unloading, hauling, excavation, installation, backfilling, labor, tools, materials, equipment and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

23.10 TEMPORARY HYDRANTS AND BLOW-OFF FOR FLUSHING AND DISINFECTION

A. GENERAL

Temporary hydrants and blow-offs shall be provided as shown on the plans or as determined by the Lincoln Water System to provide adequate discharge of water for preliminary and final flushing of the water main(s) in conformance to AWWA C651. The installation of temporary hydrants and blow-offs shall include any necessary protection of surrounding areas from damage caused by water erosion and any other provisions necessary for the conveyance of discharge water to protect downstream facilities or property.

B. BASIS OF PAYMENT

When called for in the proposal, payment for temporary hydrants and blow offs used in conformance with these Specifications and accepted by the City's Project Manager shall be made at the contract unit price bid per each for TEMPORARY HYDRANT AND BLOW-OFF. The Such payment shall be full compensation for installation of temporary hydrant and blow-off, necessary erosion protection, discharge water conveyance and downstream protection, removal of temporary hydrant and blow-off and any materials, equipment, tools, labor, or incidentals necessary to complete the work in conformance with the plans.

23.11 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION

A. GENERAL

For the purpose of constructing or reconstructing all water supply and service lines, the Contractor shall comply with the provisions of Title 17 of the Lincoln Municipal Code. The Contractor shall cause all Work to be performed by a licensed plumber. All water services that are uncovered in the course of construction shall be inspected by the Lincoln Water System to assess their integrity and recommend replacement to customers when found to be in unsatisfactory condition. All water services that are reconstructed shall be inspected by the Lincoln Water System.

All water supply or service lines which are to be looped or reconstructed shall be constructed of Type "K" seamless soft-drawn copper tubing or ductile iron pipe.

The Contractor shall place all reconstructed water services or looped water services so as to provide a minimum cover of 4'. Minimum lateral clearance from structures open to the weather, such as storm sewer inlets, shall be 3'.

All other clearance shall be a minimum of 6".

Looping a water service shall consist of the reconstruction of a water service across the width of the excavation for the facility being built or within 5' of said excavation. When the break in the service line is within 5' of either the tap or the curb stop, the Contractor shall loop the service pipe from the tap or curb stop to the opposite side of the excavation and only 1 joint will be allowed. When the break in the service line is beyond 5' from the tap or curb stop, the Contractor shall loop only that portion of service within the excavation and 2 joints will be allowed. All joints shall be located at or near the edges of the excavation and in no case shall the joints be positioned beneath other pipes or structures.

When a service constructed of lead, galvanized steel, pitted copper, or other material considered unacceptable according to Title 17 of the Lincoln Municipal Code requires looping or reconstruction, the entire service from tap to curb stop shall be replaced.

23.11 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION (Continued)

A. GENERAL (Continued)

When a water service which does not conflict with the Work is damaged by the Contractor, it must be repaired or replaced at the expense of the Contractor to the City's Project Manager's satisfaction. Copper service pipe in good condition may be repaired, all other unacceptable service materials shall be replaced from tap to curb stop.

When a service is replaced to the corporation tap, a new tap may be required. No tap shall be allowed to remain which is smaller than 3/4".

New curb stops and boxes may be required when the service is reconstructed to the curb stop. Such curb stop may be ordered to be replaced if inoperable or obsolete. All curb stops and boxes shall be supplied by the Lincoln Water System at no cost to the Contractor.

All corporation taps, labor and equipment required to replace taps will be supplied by the Lincoln Water System to the Contractor at no cost. The Contractor shall be responsible for all excavation, boring, backfilling, installation of curb stops and boxes, sod, pavement, and other incidentals necessary to complete the looping or reconstruction.

All water services crossing or paralleling a new main shall be transferred to the new main if the main is 16" or smaller.

Any tap removed from service shall be immediately abandoned at the main by the Lincoln Water System at no cost to the Contractor, unless the main is to be abandoned as part of the Work of the contract. The Contractor shall be responsible for excavation, backfill, sod, pavement and other incidentals necessary to complete the abandonment.

Whenever a water service is reconstructed that provides fire protection (fire service), the Contractor shall obtain the necessary Underground Fire Sprinkler Permit through the City's Building and Safety Department, Bureau of Fire Prevention. The Contractor shall comply with the requirements of the permit and anticipate and arrange any necessary inspections of the fire service reconstruction.

B. BASIS OF PAYMENT

When the items of Work stated below do not appear as bid items in the proposal form, all Work necessary for the looping or reconstruction of water services shall be paid for as an Extra Work item.

When the items of Work stated below are included in the proposal form, the payment shall be as follows:

COPPER WATER SERVICE PIPE or DUCTILE IRON WATER SERVICE PIPE of the various sizes called for shall be measured and paid for at the contract unit price bid per linear foot. Such payment shall be full compensation for all materials, tools, equipment, and labor including the licensed plumber, excavation, backfill, sod, clean-up and incidentals necessary to install the pipe in a manner acceptable to the City's Project Manager.

Boring for water service pipe shall be measured and paid for at the contract unit price per linear foot for BORING FOR ____" WATER SERVICE PIPE. Such payment shall be full compensation for all labor, materials, equipment, tools and incidentals necessary to produce the bore hole ready to receive the water service pipe, as accepted by the City's Project Manager. Water service pipe to be placed in the bore hole shall be paid for as provided above.

23.11 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION (Continued)

B. BASIS OF PAYMENT (Continued)

LOOP WATER SERVICE shall be measured and paid for at the contract unit price bid per each. This payment shall be full compensation for all labor, equipment, excavation, backfill, tools, incidentals, and materials except pipe, necessary to complete the Work in a manner acceptable to the City's Project Manager.

CONSTRUCT OR RECONSTRUCT WATER SERVICE shall be measured and paid for at the contract unit price bid per each. Such payment shall be full compensation for all labor, tools, and materials, except pipe and materials supplied by the City, equipment, excavation, backfill and incidentals necessary to complete the Work in a manner acceptable to the City's Project Manager.

23.12 ABANDONMENT OF WATER MAIN

A. GENERAL

When existing water mains are shown to be abandoned in place on the plans, the Contractor shall plug each end of the abandoned water main segment with a sleeve and plug or concrete after all services have been connected to the new water main for that section.

When existing water valve boxes are shown to be abandoned in place on the plans and the proposed water main is in service with service lines reconnected, the Contractor shall turn the valves to the off position, remove 1 or more feet of the top section of the valve box, fill with sand, and cap or plug with concrete.

B. BASIS OF PAYMENT

ABANDONMENT OF WATER MAIN shall be measured and paid for at the contract lump sum amount. Such payment shall be full compensation for all labor, tools, and materials necessary to complete the Work in a manner acceptable to the City's Project Manager.

23.13 HIGHWAY, STREET AND RAILROAD CROSSING

Highway, street and railroad crossings shall be constructed as indicated on the plans and as specified in the respective permits issued, if applicable. The City will obtain all necessary permits. Pipe encasement shall be constructed in conformance with Chapter 20 of these Specifications.

23.14 TESTING

The Contractor shall furnish all gauges, pumps and other equipment necessary to perform all of the acceptance tests and shall provide all assistance necessary or required by the City's Project Manager to verify the test results. No test shall be conducted until all thrust blocking has attained sufficient strength to resist any thrusts imposed by the test pressures applied.

The Contractor shall carefully fill the main or mains to be tested with water from the existing water distribution system. The Contractor shall bleed all air from pipes, valves, fittings and hydrants during filling operations. All corporation stops required to expel air shall be installed by the Lincoln Water System. The Contractor shall provide and backfill all excavations required to install corporation stops. All air taps will be abandoned by the Lincoln Water System personnel after testing is completed.

The Contractor shall pump water into the system to raise the pressure to the level indicated in the table below at the lowest elevation in the section being tested. The Contractor shall maintain the test pressure, within +/- 5 (psi), during the entire test period. The pressure testing period shall be a minimum of 2 hours. The Contractor shall carefully measure all water added to the system during that period. The rate of water added per 1,000 feet of pipeline shall not exceed maximum allowable rate as shown in TABLE 23.14 A – WATER MAIN PRESSURE TESTING.

TABLE 23.14 A – WATER MAIN PRESSURE TESTING

Nominal Pipe Size	Maximum Allowable Rate (gallons/hour)	Test Pressure (psi)
6"	0.57	200
8"	0.76	200
12"	1.15	200
16"	1.32	150
24"	1.99	150
30"	2.48	150
36"	2.98	150
48"	3.97	150
54"	4.47	150

When the pipeline being tested contains sections of various diameters, the allowable losses shall be the sum of the computed allowable losses for each size. Where sections are isolated for testing, the allowable losses will be computed for the length of sections being isolated.

During the test period, the ground surface along the length of the section being tested shall be examined for leakage. All detected leaks shall be repaired regardless of the test results.

In the event that the test requirements are not met, the Contractor shall locate and repair all defects at his own expense. Following the repairs, the tests shall be repeated until the test result requirements are met.

Pressure testing shall not be measured or paid for directly. Testing shall be considered subsidiary to those items for which direct payment is made.

23.15 DISINFECTION OF THE COMPLETED WORK

The Contractor shall keep the Work clean during construction to facilitate disinfection. All excavation and backfill required to install chlorination taps shall be provided by the Contractor.

For water mains 24" and smaller, the Contractor shall provide for the scheduling of the flushing and disinfection by the Lincoln Water System at least 24 hours in advance of the time that those services are desired. All costs of disinfection, including tests, shall be billed to and paid for by the Contractor.

For water mains 30" and larger, the Contractor shall provide a flushing and disinfection plan to the City's Project Manager for review and approval that is in conformance to the Special Provisions or the requirements specified in AWWA C651. This plan shall include the method and disinfectant to be used in disinfection process, the concentration of disinfectant to be used, the method of neutralization of the disinfectant prior to discharge into open channels or storm sewer systems. The documented results of the bacteriological tests shall be provided to the City's Project Manager with a copy to the Lincoln Water System.

Flushing and disinfection will be repeated at the Contractor's expense until bacteriological tests conducted by the Lincoln Water System indicate the system is properly disinfected.

The Work required to disinfect the system shall not be measured for direct payment. Disinfection shall be considered subsidiary to those items for which direct payment is made

23.16 COLD WEATHER CONSTRUCTION

All construction performed in cold weather or during periods where frost penetration of the soil exceeds 6" shall be in conformance with Chapter 20 of these Specifications.

23.17 SUBSTANTIAL COMPLETION

Water main Work shall be considered substantially complete when all pipe is laid, all hydrants, valves, fittings and appurtenances installed and operable, backfill complete, testing complete and accepted, disinfection complete, tap holes backfilled, water services connected, paving, sidewalks and driveways replaced, final clean-up and park space finished.

23.18 FINAL COMPLETION AND ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required Work is complete and accepted by the City's Project Manager, including all Work associated with existing water main abandonment, valve box grade adjustments, required grade adjustments to hydrants including installation of hydrant extensions in conformance to these specifications, required adjustments to hydrant nozzle orientation, seeding and/or sodding, and correction of all deficiencies found as a result of testing and/or final inspection by the City's Project Manager.

23.19 GUARANTEE

At any time during the two-year guarantee period, and within the time period allowed, the Contractor shall correct any defect in material or workmanship which has been brought to his attention. Such items shall include but not be limited to trench settlement including subsequent pavement damage, pipe leaks, damage to polyethylene encasement, hydrants out of plumb, hydrants which drain improperly, valve boxes out of plumb or offset from center of operating nut, or service line leaks.

23.20 CATHODIC PROTECTION

A. GENERAL

When called for on the plans and Contract Documents, the Contractor install cathodic protection for Ductile iron water mains having a diameter of greater than or equal to 12-inches (and their smaller appurtenances such as lateral connections to existing water mains and/or fire hydrants) that are installed using open-trench excavations and driven and bored casings. This shall not apply to water mains installed via horizontal directional drilling.

B. SUBMITTALS

1. Product Data

Submit manufacturer's specifications, recommendations, and installation instructions for each of the following main product categories and all applicable product subheadings specified in this Specification:

- a. Electrical Continuity Provisions for Ferrous Pipe (Materials and Testing Procedure)
- b. Corrosion Monitoring Test Stations, Buried Reference Electrodes and Calibrated Wire Shunts
- c. Electrical Isolation Devices
- d. Galvanic Anodes
- e. Wire, Cable, and Splices
- f. Exothermic Welds and Connection Devices

Manufacturer's product submittals shall be incorporated into a single document to demonstrate that the items have been properly coordinated by the CONTRACTOR as a unit.

- a. A notation shall be made on each shop drawing submitted as to the item's specific use by the appropriate Article-Paragraph referenced in this Specification.
- b. Multiple or incomplete submittals furnished by the CONTRACTOR may be rejected.

2. Quality Assurance

- a. Furnish the services of an individual certified by NACE International® as a Level CP2 Corrosion Technician to monitor compliance with this Specification and to ensure that the cathodic protection system components conform to this Specification.
- b. Submit the CP Technician's qualifications and prior experience before installation of any cathodic protection components.
- c. After the cathodic protection system has been installed, field commissioning of the cathodic protection system will be performed by the CP Technician furnished by the CONTRACTOR for review and approval by the CITY OF LINCOLN'S CP Specialist.

C. DELIVERY, STORAGE AND HANDLING

Manufacturers shall provide adequate care to protect cathodic protection materials from damage during handling, storage, hauling, and installation.

23.20 CATHODIC PROTECTION (Continued)

D. WARRANTY ON CONTRACTOR-PROVIDED MATERIALS

All Contractor-provided materials shall be guaranteed for a period of one year. The one-year period shall commence at the time of the final installation of all components by the Contractor and after the system has been tested and properly adjusted for operation by Lincoln Water System's Corrosion Engineer.

E. APPROVED MATERIAL SUPPLIERS

The following list of suppliers is provided for the CONTRACTOR's convenience in procuring the material required by this Specification. It shall remain the CONTRACTOR's responsibility to ensure that the materials furnished meet the physical descriptions and performance characteristics listed herein.

1. Subject to meeting the requirements of this Specification, cathodic protection materials are available from the following manufacturers-suppliers:
 - a. Mesa Products, Inc., (918-627-3188).
 - b. BK Corrosion, LLC, (713-225-0349).
 - c. T. Christy Enterprises, (800-258-4583).

F. ELECTRICAL CONTINUITY PROVISIONS – FERROUS PIPE

Insulated Stranded Copper Cable

1. The quantity and gauge of continuity bond cables required for each pipe joint shall be as shown on the CP Installation Detail Drawings included hereinafter in this Specification.
 - a. The CONTRACTOR, at his option, may install the largest gauge of continuity bond cable for all pipe sizes provided that the weld shots do not damage the pipe wall or its interior lining.
2. Bond cables shall be factory-made with formed copper sleeves installed at both ends of the bond cable using the manufacturer's proper-sized hammer dies.
3. Bond cables shall be fabricated by the same manufacturer as the exothermic weld equipment used to connect the cable to the structure.
4. Cable shall be constructed of stranded copper equipped with a high molecular weight polyethylene insulation. Insulation shall conform to ASTM D1248 – Specification for Plastic Molding and Extrusion Materials, Type 1, Class C, Grade 5 and be configured as follows:
 - a. No. of Strands: 7
 - b. Outer Jacket Thickness: 0.110 inches
 - c. Length: 18 inches (min.)
5. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - a. Continental Industries (918-627-5210), thermOweld® Jumper Bonds.
 - b. ERICO Products, Inc. (440-248-0100), Cadweld® Bonds – Formed Terminal.

23.20 CATHODIC PROTECTION (Continued)

G. CORROSION MONITORING TEST STATIONS

1. Non-Metallic Post-Type Test Stations

- a. Monitoring stations shall be a non-metallic post-type station mounted on a non-metallic conduit post. Test station shall be furnished with a capped terminal board equipped with wire/cable binding posts to permit ready access and shall be constructed as follows:

- (1) Terminal Board: Polycarbonate plastic (clear).
- (2) Test Station Cap: Polycarbonate plastic (color coded by test station type).
- (3) Conduit Post: UV stabilized polyethylene (white).
- (4) Binding Posts: Nickel-plated marine brass (6 minimum).
- (5) Shorting Bars: Nickel-plated copper.

- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:

- (1) Tinker & Rasor Company (909-890-0700), Model T-3.

2. Flush-Mounted Test Station Enclosures

- a. Test station shall be contained in a heavy-duty, polymer concrete, flush-to-grade utility enclosure able to withstand incidental traffic and constructed as follows:

- (1) The open bottom body shall be constructed of polymer concrete having a minimum compressive strength of 87 MPa.
- (2) The cover shall be constructed of polymer concrete having a non-skid surface and shall cover the body of the enclosure. Cover shall be capable of withstanding a minimum of 20,000 pounds without failure in accordance with the requirements ANSI/SCTE 77/T15 applications.
- (3) Cover shall have a minimum of two hex-capped stainless-steel hold-down bolts placed at opposite corners and shall be labeled "CP TEST" in minimum 1" high letters.

- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:

- (1) Oldcastle Polymer, Model 1324-12
- (2) New Basis, Inc. (951-787-0600) Model PCA132412S.

23.20 CATHODIC PROTECTION (Continued)

G. CORROSION MONITORING TEST STATIONS (Continued)

3. Prepackaged Cu-CuSO₄ Reference Electrodes

- a. Description: Cu-CuSO₄ electrodes shall be used for soil environments to provide a stable electrical benchmark from which to measure the cathodic protection system's effectiveness. Electrodes shall be constructed as follows:
 - (1) Element: Copper rod encapsulated in a proprietary backfill electrolyte containing high purity copper sulfate crystals and a chloride ion trap to prevent contamination of the electrolyte.
 - (2) Service life of the reference electrode shall be no less than 20 years.
 - (3) Lead Wire: No. 14 RHH-RHW (yellow) stranded copper wire. Lead wire shall be sufficiently long to reach its termination point without splicing.
- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Borin Manufacturing, Inc. (310-822-1000) Model SRE-007-CUY.
 - (2) GMC Electrical, Inc. (909-947-6016) Model CU-1-UGPC.

4. Calibrated Wire Shunts

- a. Description: Color-coded calibrated wire shunts shall be used to connect the cathodic protection system's anode header cable and structure return connection circuits.
- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Tinker & Rasor Company (909-890-0700), 0.01-ohm wire shunt with yellow mounting plate rated at 8 amps.

H. ELECTRICAL ISOLATION DEVICES

1. Plastic Pipe Inserts (PPI): In soils not known to be contaminated with hydrocarbons, PPI shall be constructed as shown on the CP Installation Detail Drawings included hereinafter in this Specification.
 - a. High Density polyethylene Pipe Inserts (HDPI) shall meet the requirements for Type III, Grade P345 Polyethylene Material as defined in ASTM Specification D-1248 (PE 3408). The minimum pressure class/SDR rating acceptable shall be Class 200/SDR 11. The pipe shall have an outside diameter matching the ductile iron pipe to which it is connected.
 - b. Mechanical joint anchor fittings shall be used to transition from ductile iron to HDPE or PVC. The fitting shall be stronger than the pipe in that when it is subjected to tensile stress the pipe will pull apart before the fitting will pull out and the pipe will blow before the fitting will rupture under pressure.

23.20 CATHODIC PROTECTION (Continued)

H. ELECTRICAL ISOLATION DEVICES (Continued)

2. Flange Isolation Kit (FIK) Assemblies: In soils not known to be contaminated with hydrocarbons, FIK shall be constructed as shown on the CP Installation Detail Drawing included hereinafter in this Specification. Provide FIK assemblies matching the pressure rating of the pipe.
 - a. FIK assemblies shall be certified by an independent certification agency to meet the requirements of the NSF-61 Standard and shall consist of the following components:
 - (1) Flange Gasket Retainer: Full-faced (Type E) G-10 Epoxy Glass.
 - (2) Sealing Elements: Ethylene propylene diene monomer (EPDM) quad O-Rings.
 - (3) Isolation Sleeves: 1/32-inch thick G-10 Epoxy Glass.
 - (4) Isolation Washers: Double 1/8-inch thick G-10 Epoxy Glass.
 - (5) Backup Washers: Double 1/8-inch thick Type 304 Stainless Steel.
 - b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) GPT, Inc.(303-988-1242) Model LineBacker®.
 - (2) Lamons® (713-222-0284) Model IsoGuard™.
3. Petrolatum Tape-Wrap Encapsulation of Buried FIK
 - a. All buried FIK shall be encapsulated in a three-part cold-applied petrolatum tape coating consisting of a primer, profiling mastic, and a low-temperature petrolatum tape.
 - (1) Primer:
 - (a.) Solids Content: 100%
 - (b.) Specific Gravity: 1.08
 - (c.) Specific Volume: 26 cubic inches/pound
 - (d.) Flash Point: > 356 °F
 - (e.) Coverage: 10-22 sq. ft./pound
 - (2) Profiling Mastic:
 - (a.) Solids Content: 100%
 - (b.) Specific Gravity: 0.605
 - (c.) Specific Volume: 46 cubic inches/pound
 - (d.) Flash Point: 356 °F
 - (e.) Coverage: Varies by application
 - (3) Low-Temperature Petrolatum Tape:
 - (a.) Thickness: 46 mils
 - (b.) Maximum Service Temperature: 122 °F
 - (c.) Roll Width: 2 inches to 12 inches
 - (d.) Roll Length: 33 feet
 - (e.) Coverage with 55% Overlap: 87 sq. ft. of tape per 100 sq. ft. of pipe

23.20 CATHODIC PROTECTION (Continued)

H. ELECTRICAL ISOLATION DEVICES (Continued)

3. Petrolatum Tape-Wrap Encapsulation of Buried FIK (Continued)

- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:

- (1) Denso NA, Inc. (281-821-3355) Denso Paste S105/Profiling Mastic/LT Tape.

4. Electrically Isolating Corporation Stops

- a. Electrically isolating corporation stops shall be constructed as follows:

- (1) All brass construction conforming to AWWA Standard C800 (ASTM B-62 and ASTM B-584).
 - (2) Solid one-piece tee-head and stem with EPDM O-ring in stem.
 - (3) Ball-style valve with molded EPDM seat to support fluorocarbon-coated brass ball.
 - (4) Factory-assembled nylon insulator installed between the body assembly and flared copper/nut service line. Individual or field-installed threaded nylon or plastic components are not acceptable.
 - (5) All threaded components must be metal. Entire assembly threads secured with adhesive to prevent unintentional disassembly and to render unit leak resistant to 300 psi working pressure.

- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following, no substitutions:

- (1) Mueller Company (770-206-4200), Model N35000N Insulated Ball Corporation Assembly.
 - (2) A.Y. McDonald (800-292-2737), Model 74701B Corporation Stop with #74755DB Copper Flare x Female Copper Flare Dielectric Bushing.

5. Casing Spacers

- a. Carrier pipe shall be contained within each steel casing sleeve by the use of casing isolation spacers.

- (1) Configuration:

- (a.) Carrier pipe shall be positioned such that the carrier rests near the bottom of the casing pipe and the height of the risers and runners shall be sized to provide a bottom clearance not less than one-half inch between the casing pipe and the extreme outside diameter of the any joint bell of the carrier pipe and a top clearance of three-fourths inch minimum.

- (2) Band Sections:

- (a.) Casing spacer shall be a two-piece shell per carrier pipe and made from T304 stainless steel of a minimum 14-gauge thickness.

23.20 CATHODIC PROTECTION (Continued)

H. ELECTRICAL ISOLATION DEVICES (Continued)

5. Casing Spacers (Continued)

(2) Band Sections: (Continued)

- (b.) Each shell section shall be lined with a 0.090" thick, ribbed PVC extrusion with a retaining section that overlaps the edges of the shell and prevents slippage.
- (c.) PVC Liner shall have a hardness of 85-90 durometer.
- (d.) Bearing surfaces (runners) shall be ultra-high molecular weight polyethylene (UHMW) to provide abrasion resistance and a low coefficient of friction (0.12).

(3) Runners:

- (a.) The runners shall be attached to the support risers at appropriate positions to properly support the carrier pipes within the casing pipe and to ease installation.
- (b.) The runners shall be mechanically bolted to the spacer.

(4) Risers:

- (a.) Risers shall be MIG welded to the shell, where applicable.
- (b.) Risers shall be made of T304 stainless steel of a maximum 10 gauge with bolt heads welded to the inside of the risers for strength.
- (c.) Bottom risers 6" and over in height shall be reinforced. All reinforcing plates shall be 10-gauge T304 stainless steel and shall be MIG welded to mating parts.
- (d.) All weldments shall be fully chemically passivated in accordance with ASTM A380.

- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:

- (1) Cascade Waterworks Manufacturing Co. (800-426-4301), Model CCS.
- (2) Advance Products and Systems, Inc. (337-233-6116), Model SSI.
- (3) The BWM Company (828-247-0630). Model SS-Pipe Size.

6. Pipe Penetration Sleeve Seals

- a. Isolating sleeve seals shall be modular mechanical type constructed of expanding, interlocking links shaped to continuously fill and seal the annular space between the carrier pipe and the sleeve or opening, and shall be constructed as follows:

- (1) Links: Synthetic rubber.
- (2) Fasteners: Zinc-coated steel.

- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:

- (1) GPT, Inc. (303-988-1242) Model Link-Seal®.
- (2) Advance Products and Systems, Inc. (337-233-6116), Model Innerlynx®.

23.20 CATHODIC PROTECTION (Continued)

H. ELECTRICAL ISOLATION DEVICES (Continued)

7. Casing End Seals

- a. Casing end seals shall be wrap-around style and shall be constructed as follows:
 - (1) Annulus Wrapping: 1/8-inch thick neoprene rubber.
 - (2) Hold-down Banding: 1/2-inch wide Type 304 SS worm gear banding.
- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) GPT, Inc. (303-988-1242) Model S Pull-On End Seal.
 - (2) Advance Products and Systems, Inc. (337-233-6116), Model AM End Seal.

I. GALVANIC ANODES

1. Magnesium Anodes

- a. Description: Magnesium anodes shall be capable of delivering a minimum efficiency of 500 amp-hours per pound of magnesium and shall have the following metallurgical analysis:
- b. Quality Assurance: Furnish spectrographic analysis for assurance of chemical composition and ASTM G97 for verification of electro-chemical properties on samples from each heat or batch of anodes supplied for this project.
- c. Metallurgy:
 - (1) Aluminum: 0.01% (max.)
 - (2) Manganese: 0.50% - 1.3%
 - (3) Copper: 0.02% (max.)
 - (4) Nickel: 0.001% (max.)
 - (5) Iron: 0.03% (max.)
 - (6) Other (each): 0.05% (max.)
 - (7) Other (total): 0.30% (max.)
 - (8) Magnesium: Balance
- d. Packaged Magnesium Anode Backfill: Completely surround the anode ingot in backfill without voids. Provide magnesium anodes packaged within a cotton sack in a special chemical backfill having the following proportions:
 - (1) Ground Hydrated Gypsum: 75%
 - (2) Powdered Bentonite: 20%
 - (3) Anhydrous Sodium Sulfate: 5%
 - (4) Provide backfill with a grain size such that 100% is capable of passing a 20-mesh screen and 50% is retained by the 100-mesh screen.

23.20 CATHODIC PROTECTION (Continued)

I. GALVANIC ANODES (Continued)

1. Magnesium Anodes (Continued)

e. Anode Lead Wire

- (1) The standard lead wire for a magnesium anode shall be at least 10 feet in length of No. 12 AWG solid copper wire with Type TW (red) thermoplastic insulation
- (2) Lead Wire Connection to Anode Core
 - (a.) Magnesium anodes shall be cast with a minimum 20-gauge galvanized steel core.
 - (b.) One end of the anode shall be recessed to expose the core for silver-soldering the lead wire.
 - (c.) The silver-soldered lead wire connection and anode recess shall be filled with an electrical potting compound before packaging.

(3) Magnesium Anode Physical Parameters

Anode Weight (#)		Nominal Package Dimensions (in.)	
Bare Anode	Pkg'd Anode	Length	Diameter
48	98	38	8.0

- f. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Mesa Products, Inc., (918-627-3188).
 - (2) BK Corrosion, LLC, (713-225-0349).
 - (3) T. Christy Enterprises, (800-258-4583).

2. Zinc Anodes

- a. Description: Zinc anodes shall be capable of delivering a minimum efficiency of 335 amp-hours per pound of zinc.
- b. Quality Assurance: Furnish spectrographic analysis for assurance of chemical composition for verification of electro-chemical properties on samples from each heat or batch of anodes supplied for this project.
- c. Metallurgy:
 - (1) Aluminum: 0.005% (max.)
 - (2) Cadmium: 0.003% (max.)
 - (3) Iron: 0.0014% (max.)
 - (4) Lead: 0.003% (max.)
 - (5) Copper: 0.002% (max.)
 - (6) Zinc: Balance

23.20 CATHODIC PROTECTION (Continued)

I. GALVANIC ANODES (Continued)

2. Zinc Anodes (Continued)

- d. **Packaged Zinc Anode Backfill:** Completely surround the anode ingot in backfill without voids. Provide Zinc anodes packaged within a cotton sack in a special chemical backfill having the following proportions:

- (1) Ground Hydrated Gypsum: 75%
- (2) Powdered Bentonite: 20%
- (3) Anhydrous Sodium Sulfate: 5%
- (4) Provide backfill with a grain size such that 100% is capable of passing a 20-mesh screen and 50% is retained by the 100-mesh screen.

e. **Zinc Anode Lead Wire**

- (1) The standard lead wire for a Zinc anode shall be at least 10 feet in length of No. 12 AWG solid copper wire with Type TW (red) thermoplastic insulation

- (2) **Lead Wire Connection to Anode Core**

- (a.) Zinc anodes shall be cast around a centralized ¼-inch diameter electro-galvanized mild steel rod core.
- (b.) Lead wire shall be silver-soldered to the rod core.
- (c.) Wrap soldered connection with two half-lapped layers of rubber tape followed by two half-lapped layers of vinyl tape.

f. **Zinc Anode Physical Parameters**

Anode Weight (#)		Nominal Package Dimensions (in.)	
Bare Anode	Pkg'd Anode	Length	Diameter
60	130	66	5.5

- g. Subject to meeting the requirements of this Special Provision, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:

- (1) Mesa Products, Inc., (918-627-3188).
- (2) BK Corrosion, LLC, (713-225-0349).
- (3) T. Christy Enterprises, (800-258-4583).

23.20 CATHODIC PROTECTION (Continued)

J. WIRE, CABLE AND SPLICES

1. Anode Header Cable and Structure Return Connection (Direct Burial)

- a. High molecular weight polyethylene insulated stranded copper cable shall be used for all underground portions of the cathodic protection system's anode header cable and structure return connection circuits. Insulation shall conform to ASTM D1248 – Specification for Plastic Molding and Extrusion Materials, Type 1, Class C, Grade 5.
- b. The DC cables shall be sized as follows:
 - (1) No. of Strands: 7
 - (2) Outer Jacket: 0.110" thickness
 - (3) Anode Header Cable: No. 8 AWG (red)
 - (4) Structure Return Connection: No. 8 AWG (blue)

2. Test Wires for CP System Monitoring (Direct Burial)

- a. Cross-linked polyethylene (XLPE) Type RHW-2 and USE-2 for use at 600 volts or less shall be used for all underground structure connections as part of the CP system's monitoring circuit. Wire insulation shall conform to NEC for direct burial, general-purpose applications at a maximum continuous operating temperature of 90 degrees C in either wet or dry locations.
- b. The test wires shall be configured as follows:
 - (1) Conductors shall be Class B stranded annealed uncoated copper per UL Standard 854 and 44.
 - (2) Primary Insulation: 0.045" thickness
 - (3) Gauge and Structure Color Code: #12 AWG (colors as shown on drawings)
- c. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Graybar Electric Company (800-472-9227)
 - (2) Omni Cable Corp. (800-292-6664)
 - (3) Kris-Tech Wire (315-339-5268)

3. Compression Crimp Splice Connectors

- a. All underground spliced connections used within the DC cathodic protection circuit shall be made through the use of copper compression crimp connectors.
 - (1) The proper size connectors shall be used in accordance with the manufacturer's recommendations.
 - (2) Connectors shall be crimped with a hand tool capable of delivering a minimum of 9000 pounds of compressive force.
- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Burndy LLC-US (800-346-4175).

23.20 CATHODIC PROTECTION (Continued)

J. WIRE, CABLE AND SPLICES (Continued)

4. Splice Encapsulation

- a. All underground spliced connections used within the DC cathodic protection circuit shall be sealed with rubber and plastic tape contained within a waterproof coating.
- b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) 3M Electrical Products (1-888-364-3577) - Scotch Brand 23 Rubber Splicing Tape.
 - (2) 3M Electrical Products (1-888-364-3577) - Scotch Brand 33+ Vinyl Electrical Tape.
 - (3) 3M Electrical Products (1-888-364-3577) - Scotchkote Electrical Coating.

K. EXOTHERMIC WELDS AND CONNECTION DEVICES

1. All connections used within the DC cathodic protection system circuit shall be by exothermic welds.
 - a. The proper size welders, metal charges, and wire sleeves shall be used in accordance with the manufacturer's recommendations. Do not mix different manufacturers' products.
 - (1) When connecting to horizontal ductile iron or cast-iron structures, use a maximum of 32-gram weld metal charge and furnaces designated specifically for cast iron.
 - (2) When connecting to horizontal carbon steel structures, use a maximum of 25-gram weld metal charge and furnaces designated specifically for carbon steel.
 - b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Continental Industries (918-627-5210), Model thermOweld®.
 - (2) ERICO Products, Inc. (440-248-0100), (440-248-0100), Model Cadweld®.
2. Coating of Wire and Cable Connections to Structures
 - a. A pre-fabricated plastic sheet with an igloo-shaped dome and entry tunnel filled with an oil- and gas-resistant elastomeric rubber and a primer-less elastomeric tape for bonding directly to the structure.
 - b. Subject to meeting the requirements of this Specification, acceptable manufacturer's products which may be incorporated into the work include the following *or an approved equal*:
 - (1) Continental Industries (918-627-5210), Model thermOcap® PC.
 - (2) Chase Corporation (781-332-0700), Model Royston Handy Cap® IP.

23.20 CATHODIC PROTECTION (Continued)

L. INSTALLATION OF CATHODIC PROTECTION MATERIALS - GENERAL

Examine the areas and conditions under which cathodic protection materials are to be installed and notify RESIDENT PROJECT REPRESENTATIVE in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

Drawings: Install all cathodic protection components and equipment according to the following CP Installation Detail Drawings included hereinafter in this Specification.

1. Drawing No. CP-101: Single Horizontal Anode Installation
2. Drawing No. CP-102: Single Vertical Anode Installation
3. Drawing No. CP-301: Continuity Bonding across Ductile Iron Pipe Joint
4. Drawing No. CP-311: Continuity Bonding across Vertical Gate Valve
5. Drawing No. CP-312: Continuity Bonding across Butterfly Valve or Horizontal Gate Valve
6. Drawing No. CP-321: Insulating Rubber & Tape Wye Splice for Sacrificial Anode Cable Connections
7. Drawing No. CP-322: Insulating Rubber & Tape Butt Splice for Sacrificial Anode Cable Connections
8. Drawing No. CP-401: Exothermic Weld Procedure for Ferrous Pipe Material (Horizontal Only)
9. Drawing No. CP-611: Anode Test Station (ATS)
10. Drawing No. CP-612: ATS Terminal Board Installation Details
11. Drawing No. CP-621: Casing Test Station (CTS)
12. Drawing No. CP-622: CTS Terminal Board Installation Details
13. Drawing No. CP-631: Potential Test Station (PTS)
14. Drawing No. CP-632: PTS Terminal Board Installation Details
15. Drawing No. CP-641: Foreign Crossing (Over WM) Test Station (FTS)
16. Drawing No. CP-642: Foreign Crossing (Under WM) Test Station (FTS)
17. Drawing No. CP-643: FTS Terminal Board Installation Details
18. Drawing No. CP-651: Isolation Test Station (ITS)
19. Drawing No. CP-652: ITS Terminal Board Installation Details
20. Drawing No. CP-653: Isolation Test Station at Tapping Sleeve (ITS-TAP)
21. Drawing No. CP-691: Flush-Mounted Enclosure for Test Station Terminal Board & Wires
22. Drawing No. CP-692: Post-Mounted Test Station for Terminal Board & Wires
23. Drawing No. CP-801: Flange Isolation Kit (FIK)
24. Drawing No. CP-804: Polyvinyl Chloride Pipe Insert (PVPI)
25. Drawing No. CP-805: High Density polyethylene Pipe Insert (HDPI)
26. Drawing No. CP-806: Isolation (Ball Type) Corporation Stop (ICS)
27. Drawing No. CP-807: Isolation Service Fitting (Copper Flare) for ¾" to 2" Pipe (ISF)
28. Drawing No. CP-808: Electrical Isolation Devices for Metallic Casing Sleeves
29. Drawing No. CP-809: Electrical Isolation at Pipe Entry with Reinforced Concrete Wall

23.20 CATHODIC PROTECTION (Continued)

M. INSTALLATION OF CATHODIC PROTECTION MATERIALS – QUALITY CONTROL

1. CONTRACTOR's Quality Control System

Implement a quality control system monitored to ensure that the standards for materials, workmanship, construction, and functional performance established by this Specification are adhered to throughout the course of the Work.

2. CONTRACTOR's Technical Assistance

The CONTRACTOR shall have access (via telephonic assistance) from cathodic protection system material suppliers throughout the duration of the Work.

N. INSTALLATION OF ELECTRICAL CONTINUITY PROVISIONS – FERROUS PIPE

1. General: Factory-made cable bonds shall be installed across all non-welded ferrous pipe joints except as follows:

- a. Pipe joints that are specifically required to be electrically isolated.
- b. Bond around all valves - do not connect cable bonds to valve housing.

2. Method:

- a. Inspect each bond cable to ensure a continuous electrical conductor with no cuts or tears in the cable insulation.
- b. Attach bond cable to water main by the exothermic welding process in accordance with the manufacturer's instructions.
- c. Do not use any exothermic weld equipment that is either damp or wet.
- d. Cover all exothermic welds with a pre-fabricated, igloo-shaped, domed-plastic elastomeric rubber cover as described in this Specification.

3. Post-Installation Visual Inspection: Inspect all electrical continuity bond cable connections by visually examining each exothermic weld connection for strength and suitable coating prior to backfilling.

4. Post-Installation Continuity Testing: CONTRACTOR shall use the following procedure to verify all bonded pipe joints are electrically continuous prior to backfilling. All data shall be documented for the job record and submitted each day to the CITY OF LINCOLN and also summarized and submitted to the CITY OF LINCOLN at the completion of the project.

- a. Measure the electrical potential at each side of selected bonded connections with a portable copper/copper-sulfate reference electrode (CSE) and a digital voltmeter having at least 10 mega-ohm input impedance.
- b. Place the CSE into the soil within 18-inches of the bonded connection and do not move the CSE.
- c. Connect the red meter lead to the CSE and the black meter lead to the pipe (not the cable). Ensure a secure direct contact to the pipe by using an awl or similar tool.

23.20 CATHODIC PROTECTION (Continued)

N. INSTALLATION OF ELECTRICAL CONTINUITY PROVISIONS – FERROUS PIPE (Continued)

4. Post-Installation Continuity Testing (Continued)

- d. Measure and record the DC voltage between the CSE and the pipe on EACH side of the bonded connection.
 - e. The two DC voltage readings must be identical to indicate an acceptable connection.
5. Acceptance Criterion: If, in the opinion of the CITY OF LINCOLN, any exothermic weld is deficient, the CONTRACTOR shall remove and replace the deficient welded connection at no expense to the City of Lincoln.
6. Backfilling of Bond Cables:
- a. Perform backfilling that will prevent damage to the bond cables and connections to the water main.
 - b. If construction activity damages a bond cable, the CONTRACTOR shall remove and replace the bond cable at no expense to the CITY OF LINCOLN.

O. INSTALLATION OF CORROSION MONITORING TEST STATIONS

- 1. General: Install the required number of test stations at the locations shown or as directed by the CITY OF LINCOLN.
- 2. Reference Electrode
 - a. Keep permanent reference electrodes dry and protect from freezing before installation.
 - b. Remove plastic or paper shipping bags from around the reference electrode prior to installation.
 - c. Place reference electrode in native soil within 12 to 36 inches of the water main.
- 3. Test Wires
 - a. Provide test station lead wires that are continuous with no cuts or tears in the insulation covering the conductor.
 - b. Attach test leads to the water main by the exothermic welding process.
 - c. Connect all test station wires to one side of the terminal board using the test station manufacturer's standard binding posts at the locations shown on the Plans.
 - d. Install wire shunt plate and shorting bars to the opposite side of terminal board from the incoming wires.
 - e. Install wire shunt plate last to permit easy removal from terminal board without having to disassemble other test station wire and cable connections.

23.20 CATHODIC PROTECTION (Continued)

O. INSTALLATION OF CORROSION MONITORING TEST STATIONS (Continued)

4. Terminal Board and Test Stations within Flush-Mounted Enclosure:

- a. Route all test station wires through the mounting pipe and run to an area along the water main that will not accumulate standing water or allow the test station to be silted over.
- b. Install the test station terminal board on top of the mounting pipe and extend the pipe vertically to allow at least 24" below bottom of the enclosure.
- c. Install the top of test station head and color-coded cap to allow a minimum separation of 1" from the underside of the enclosure cover. Permanently mark as-built pipeline stationing number on test station cap or mounting post.
- d. Set the top of the enclosure flush to final grade outside of vehicular traffic areas and support with a minimum 6" gravel base to support and drain the inside of the enclosure.
- e. Fasten the two hold-down bolts of the enclosure lid but do not over tighten.
- f. Thoroughly backfill and compact the soil surrounding the enclosure to prevent settling and voids.
- g. Drive a vertical 12-inch long steel rebar flush into the ground and immediately alongside the enclosure to facilitate locating with a magnetic sensing device.

5. Terminal Board and Test Stations on Mounting Post:

- a. Route all test station wires through the mounting pipe and run to an area along the water main that will not accumulate standing water.
- b. Install the test station terminal board on top of the mounting pipe and extend the pipe vertically to a height of at least 36" to 42" above final grade.
- c. Install the top of test station head and color-coded cap. Permanently mark as-built pipeline stationing number on test station cap or mounting post.
- d. Thoroughly backfill and compact the soil surrounding the mounting post to prevent settling and voids.
- e. Install CITY OF LINCOLN-supplied bollard/post in areas with high vegetation that could obscure test station's PE mounting post.
- f. Affix CITY OF LINCOLN-supplied adhesive identification label to test station's mounting pipe.

23.20 CATHODIC PROTECTION (Continued)

O. INSTALLATION OF CORROSION MONITORING TEST STATIONS (Continued)

6. Post-Installation Backfilling

- a. Protect test leads during the backfilling operation to avoid damage to the wire insulation and integrity of the conductor.
- b. Protect permanent reference electrode during backfilling to avoid damage to the electrode and its lead wire.
- c. If, in the opinion of the CITY OF LINCOLN, the installation of the test station wires or the reference electrode is deficient, the CONTRACTOR shall remove and replace these components at no expense to the City of Lincoln.

P. INSTALLATION OF ELECTRICAL ISOLATION DEVICES

1. General: Install the required number of electrical isolation devices at the locations shown on the CP Installation Schedule provided hereinafter in this Specification or as directed by the CITY OF LINCOLN. The water main intended for cathodic protection shall be electrically isolated at the following locations:
 - a. At all copper water service laterals at the corporation stop.
 - b. At all metallic casing sleeves beneath street or rail crossings.
 - c. At all connections to existing metallic water mains or at connections to new water mains that are not intended for cathodic protection.
2. Casing Isolation Testing:
 - a. After casing spacers are installed but prior to grouting of the casing annulus, perform electrical isolation test to verify that casing and carrier pipes are electrically separated as follows:
 - (1) Measure and record the DC voltage difference between the casing and the carrier pipes using a digital voltmeter having at least 10 mega-ohm input impedance.
 - (2) If the DC voltage difference is not greater than zero DC millivolts, remove electrical connection between the casing and carrier pipes to provide electrical separation and repeat the electrical isolation test. Do not grout the casing annulus until a DC voltage difference of greater than zero DC millivolts is measured and recorded.
3. Flange Isolation Kit (FIK) Procedure:
 - a. Inspect the gasket kit and verify that the material is as specified and that the material is not damaged.
 - b. Clean the bolting materials. Apply lubricant or anti-seizing compound to all threads required for alignment with nuts and nut facings.

23.20 CATHODIC PROTECTION (Continued)

P. INSTALLATION OF ELECTRICAL ISOLATION DEVICES (Continued)

3. Flange Isolation Kit (FIK) Procedure: (Continued)

- c. Align flange faces so that they are parallel and concentric with each other and within 0.010 inch without external loading or springing.
- d. Line up bolt holes by driving two tapered drift pins in opposite directions to each other into two diametrically opposite bolt holes.
- e. Insert insulating sleeves into bolt holes. Sleeves must slide in easily; if not, flanges must be realigned. Do not force sleeves into bolt holes.
- f. Assemble studs/bolts as follows:
 - (1) Run one nut on each stud so that two full threads are showing beyond the nut.
 - (2) Slide steel backup washer onto stud and insert into bolt hole. If flange requires two-sided insulation, add an insulating washer after the steel washer.
 - (3) From the opposite end of the stud, place an insulating washer, steel backup washer, and a nut; tighten by hand.
 - (4) Torque the first two studs at diametrically opposite locations to a maximum of 30 percent of the final torque value in a star pattern.
 - (5) Repeat star-torqueing pattern at each bolt by increasing torque to 50-60 percent of final value.
 - (6) Continue torqueing all studs in a star pattern using the specified torque setting (100 percent) until there is no further rotation of the nuts.
- g. Acceptance
 - (1) Immediately after a FIK has been installed in accordance with the manufacturer's specifications, the CONTRACTOR will perform an electrical isolation test using a radio frequency isolating test meter to verify the flange will not permit current flow across it.
 - (2) If, in the opinion of the CITY OF LINCOLN, the FIK is shorted, the CONTRACTOR shall remove and replace the isolation gasket or bolt sleeves/washers at the CONTRACTOR's expense.
- h. Sealing Buried Isolation Flanges
 - (1) After any buried FIK has been tested and found to be 100 percent effective, the entire isolator shall be encapsulated in a three-part, non-toxic, petrolatum tape wrap before burial.
 - (2) Encapsulation shall completely cover both flange sides and shall extend a minimum of six inches beyond the ends of all flange bolt heads and nuts.

23.20 CATHODIC PROTECTION (Continued)

Q. INSTALLATION OF GALVANIC ANODES

1. General: Install the required number of anodes at the locations shown on the CP Installation Schedule provided hereinafter in this Specification or as directed by the CITY OF LINCOLN.
2. Method
 - a. Remove plastic or paper shipping bags from around prepackaged anodes prior to installation.
 - b. Install in the manner and at the dimensions from the water main as shown on the CP Installation Details. Field modifications shall be made only with the approval of the CITY OF LINCOLN.
 - c. Handle galvanic anodes in such a manner to avoid damaging anode materials and wire connections.
 - d. Attach anode lead wire to insulated header cable or route lead wire directly to pipe or test station as required.
 - e. Splices are not permitted within the length of a factory-fabricated anode lead wire.
 - f. Install prepackaged anodes with compacted backfill material, such that no voids exist between the anode material and the backfill.
 - g. In soils that do not exhibit any signs of moisture content or granular soils that have no cohesive strength, pour 5 gallons of water over the anode after backfilling and tamping have been completed to a point about 6 inches above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

R. INSTALLATION OF WIRE, CABLE AND SPLICES

1. Install underground wires, cables, and connections at a minimum 36 inches below final grade with a minimum separation of 6 inches from other underground structures.
2. Seal splices against water penetration as follows:
 - a. Clean and then wrap with a minimum of two half-lapped layers of rubber electrical tape.
 - b. Apply two half-lapped layers of plastic electrical tape.
 - c. Cover with a fast-drying electrical sealant.

23.20 CATHODIC PROTECTION (Continued)

S. INSTALLATION OF EXOTHERMIC WELDS AND CONNECTION DEVICES

1. All exothermic welding shall be performed in accordance with the manufacturer's recommendations for welding equipment, weld metal charge size, and applicability to the structure. Do not use exothermic weld equipment if the graphite mold is wet.
2. Structure Surface Preparation
 - a. All bare metal shall be free of dust, dirt, grease, oil and other foreign matter.
 - b. Practical removal shall be by either power or hand wire brushing.
 - c. Grinding or filing shall remove sharp edges or burrs.
3. Installation of Elastomeric Cover over Exothermic Welds
 - a. Clean the pipe surface which is to be covered by removing all moisture, dirt, grease and other contaminants.
 - b. The weld areas shall be no more than warm to the touch before applying the elastomeric cover.
 - c. Remove the release paper from the back of the mastic pad. Avoid touching the exposed elastomeric tape.
 - d. Apply the mastic pad to the structure by firmly pressing on all edges making sure that the tunnel area of the plastic dome completely covers the lead wire entering the exposed copper of the connection.
 - e. Push the dome of the plastic weld cap firmly over the exothermic weld area and the wire entering the weld cap.

T. POST-INSTALLATION TESTING OF CATHODIC PROTECTION SYSTEMS

1. General: CITY OF LINCOLN will provide services of a NACE-certified CP Specialist for periodic field inspections and technical oversight of the CONTRACTOR's commissioning services of the cathodic protection system in accordance with the following NACE International® reference standard and standard test method:
 - a. NACE International® Standard Practice SP0169 (latest edition).
 - b. NACE International® Standard Test Method TM0497 (latest edition).
2. After installation of the cathodic protection system, field tests including the following items will be performed by the CP Technician furnished by the CONTRACTOR:
 - a. Take photographs of each test station – both of the terminal board and also the surrounding landscape for future identification and locating.
 - b. Verify that each test station wire is attached to the appropriate structure using the proper color code.

23.20 CATHODIC PROTECTION (Continued)

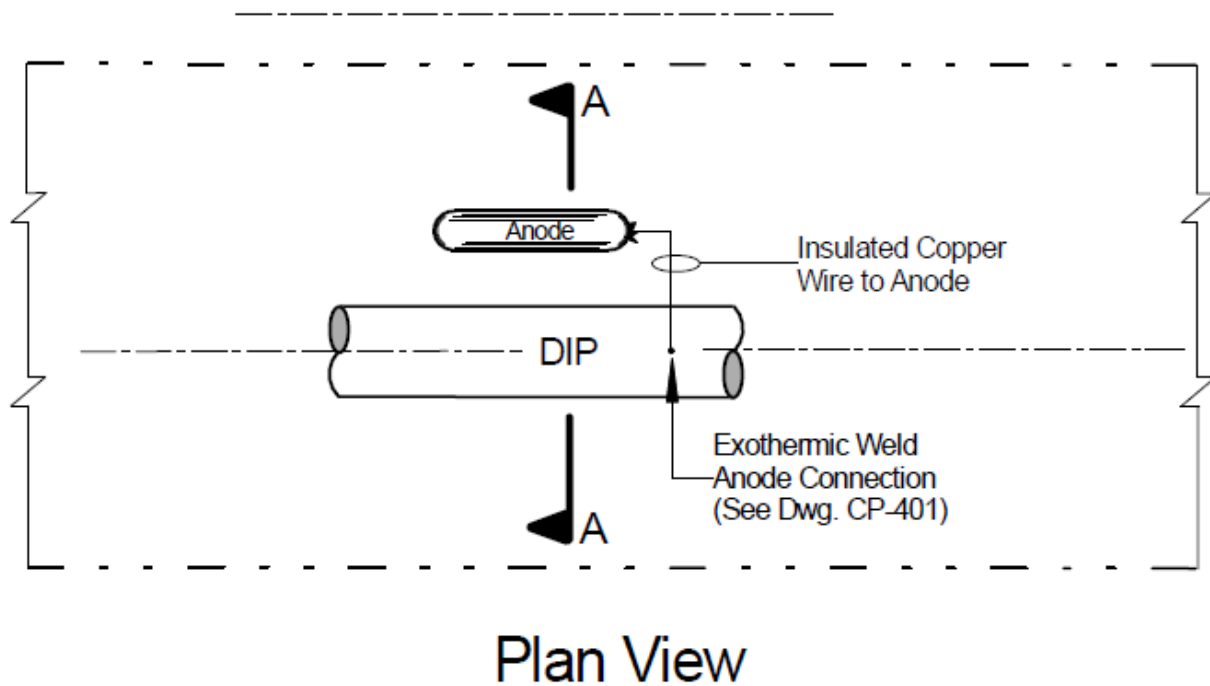
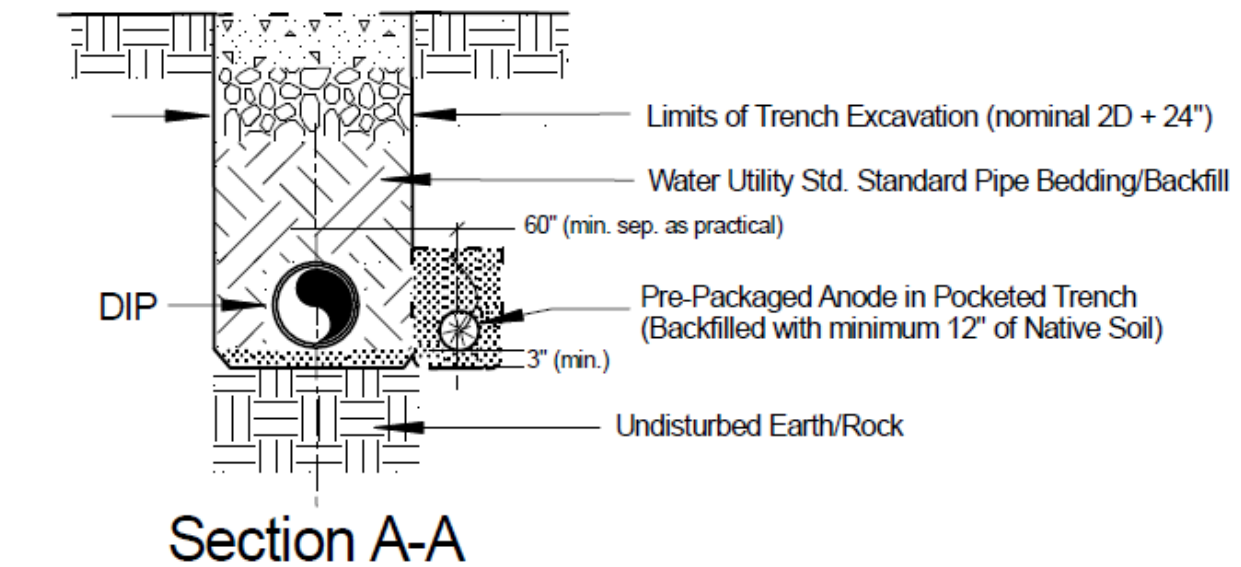
T. POST-INSTALLATION TESTING OF CATHODIC PROTECTION SYSTEMS (Continued)

2. After installation of the cathodic protection system, field tests including the following items will be performed by the CP Technician furnished by the CONTRACTOR: (Continued)
 - c. Measure cathodic protection data at each test station as follows:
 - (1) Red Cap Anode Test Station: ON S/S potentials of the pipeline using the buried reference electrode and a portable Cu-CuSO₄ reference cell. Momentarily disconnect the anode(s) from the circuit and record Instant-Off S/S potentials of the pipeline using the buried reference electrode and a portable Cu-CuSO₄ reference cell. Measure the total current through the anode circuit via the TS shunt.
 - (2) Orange Cap Isolation Test Station: Structure-to-soil potentials of the pipeline and the foreign structure (across the FIK) using the buried Cu-CuSO₄ reference electrode and a portable reference cell.
 - (3) Blue Cap Casing Test Station: Structure-to-soil potentials of the pipeline and the casing using the buried reference electrode and a portable Cu-CuSO₄ reference cell.
 - (4) Green Cap Potential Test Station: Structure-to-soil potentials of the pipeline using the buried reference electrode and a portable Cu-CuSO₄ reference cell.
 - (5) White Cap Foreign Test Station: Structure-to-soil potentials of the pipeline and the foreign structure using the buried reference electrode and a portable Cu-CuSO₄ reference cell. Note any DC interference to the pipeline.
 - d. Determine the effectiveness of each accessible electrical isolation device.
 - e. Prepare and submit a summary report to the CITY OF LINCOLN and RESIDENT PROJECT REPRESENTATIVE containing to include a description of the structures intended for protection, a description of the cathodic protection systems, and a tabulation/analysis of the data versus NACE International® performance standards.
3. Final Acceptance: Assist the CITY OF LINCOLN's CP Specialist after energizing and commissioning of the cathodic protection system to ensure that deficiencies are corrected prior to acceptance by the RESIDENT PROJECT REPRESENTATIVE.
 - a. The costs for any additional field tests or inspections by the CITY OF LINCOLN's CP Specialist that result from either material or installation deficiencies will be charged to the CONTRACTOR at direct cost with no mark-up and deducted from the CONTRACTOR's final pay application for the project.
 - b. The cathodic protection system installation will be deemed acceptable for full payment only after being tested by the CONTRACTOR's CP Technician and determined to meet the minimum performance criterion established in this Specification by the CITY OF LINCOLN'S CP Specialist.

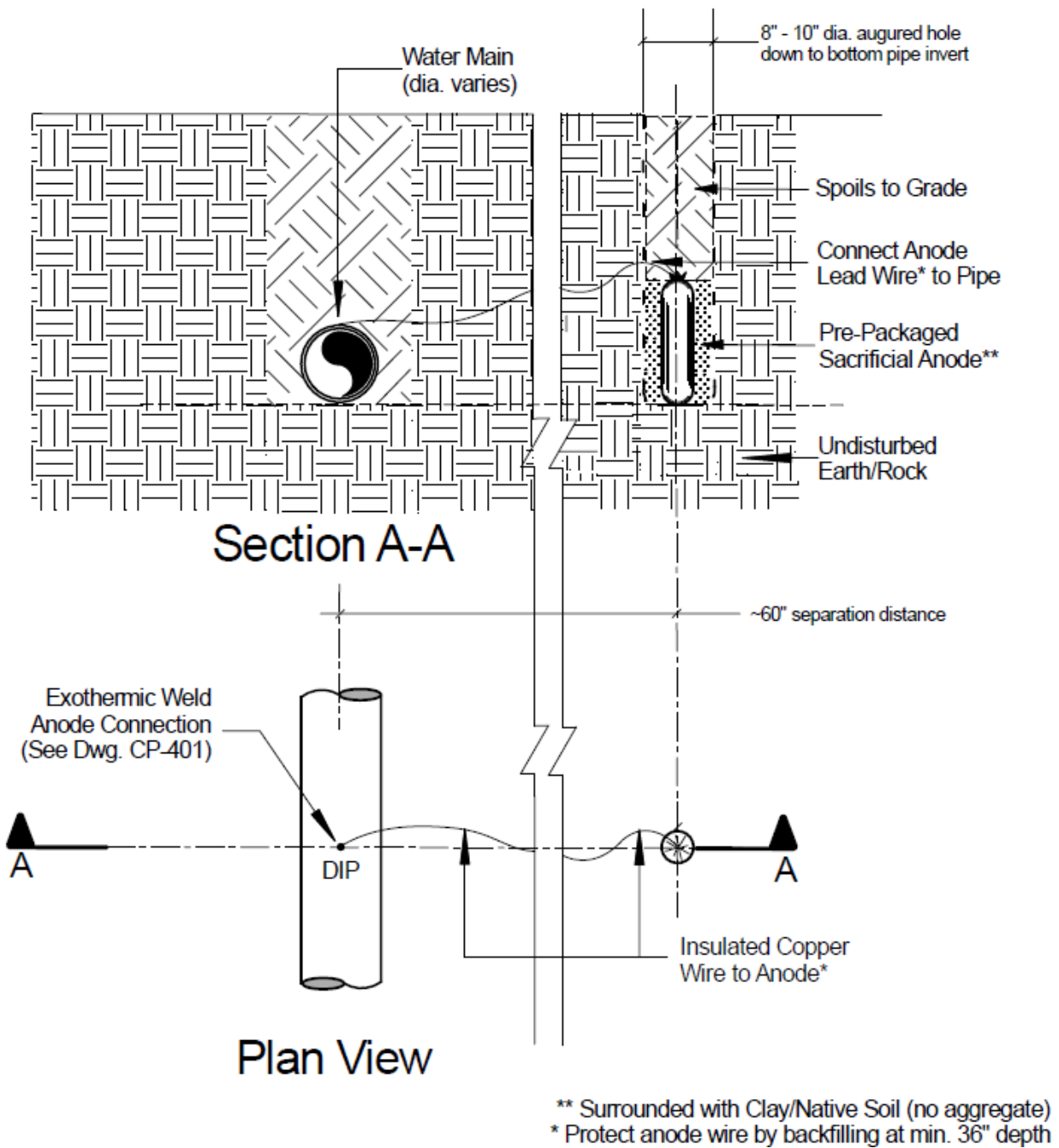
U. BASIS OF PAYMENT

All Cathodic Protection components installed per this Chapter, as shown on the plans or as directed, shall be paid for at the contract unit price bid per Lump Sum for CORROSION CONTROL SYSTEM. Such price shall be full compensation for all loading and unloading, hauling, excavation, installation, backfilling, labor, tools, materials, equipment and incidentals necessary to complete the Work in conformance with these Specifications and as accepted by the City's Project Manager.

DRAWING NO. CP-101
SINGLE HORIZONTAL ANODE INSTALLATION



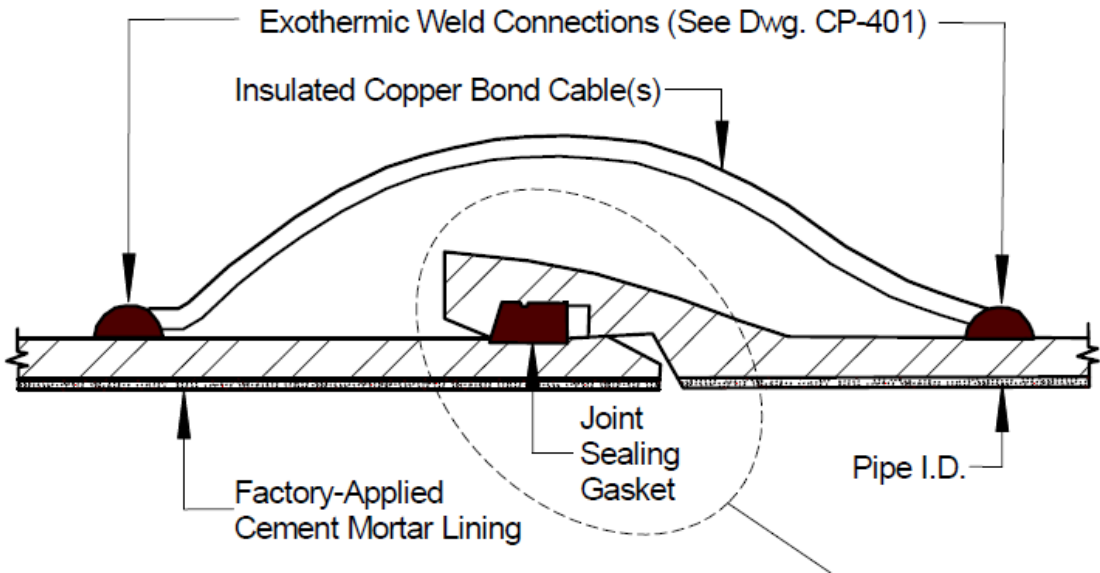
DRAWING NO. CP-102
SINGLE VERTICAL ANODE INSTALLATION



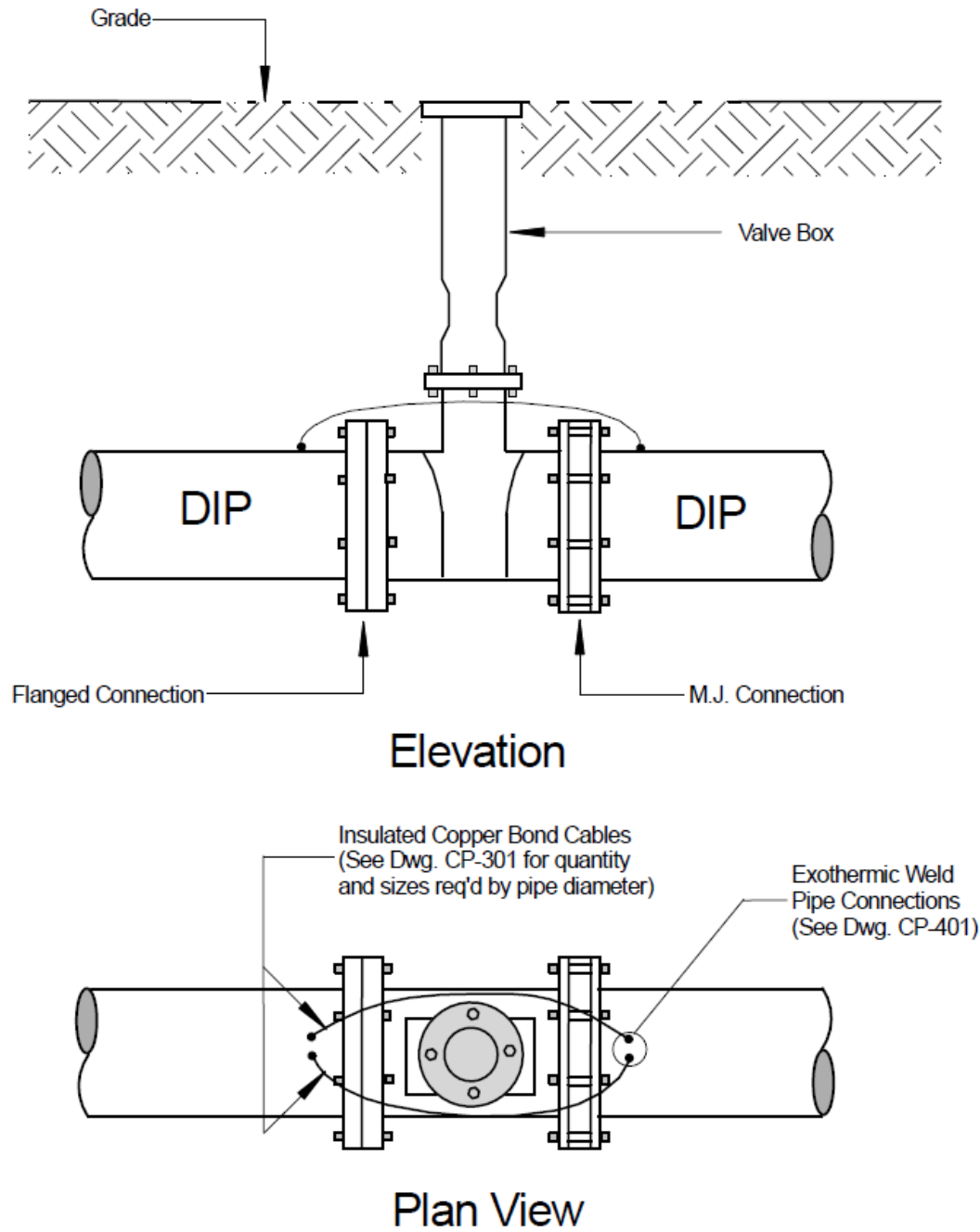
DRAWING NO. CP-301
CONTINUITY BONDING ACROSS DUCTILE IRON PIPE JOINT

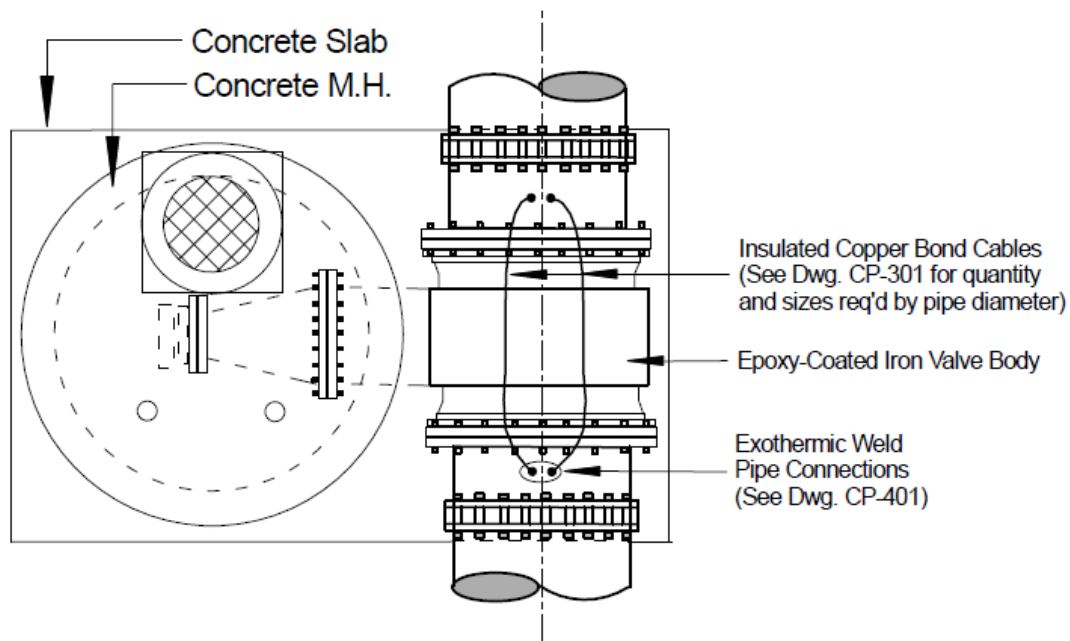
Pipe Joint Bonding Information	Pipe Dia. (in.)	Pipe Mat'l	Continuity Bond	
			Min. Cable Sizes	
			Qty.	AWG #
	> 24	DIP	3	2
	16 to 24	DIP	2	2
	10 to 14	DIP	2	4
	6 to 8	DIP	1	8
Refer to City of Lincoln Special Provisions for material and installation requirements				

Note: Bonding across water main valves shall be as shown on CP-311 and CP-312

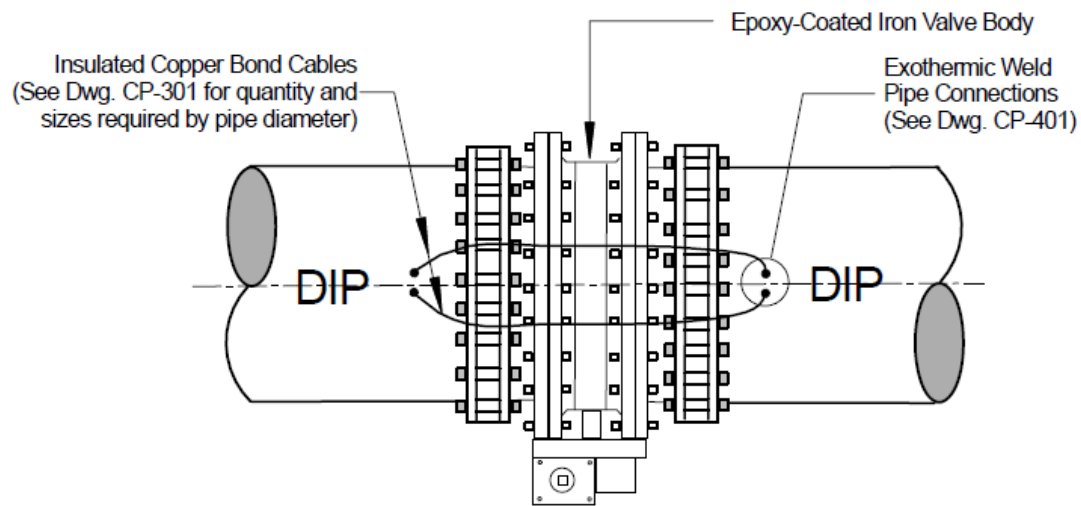


DRAWING NO. CP-311
CONTINUITY BONDING ACROSS VERTICAL GATE VALVE

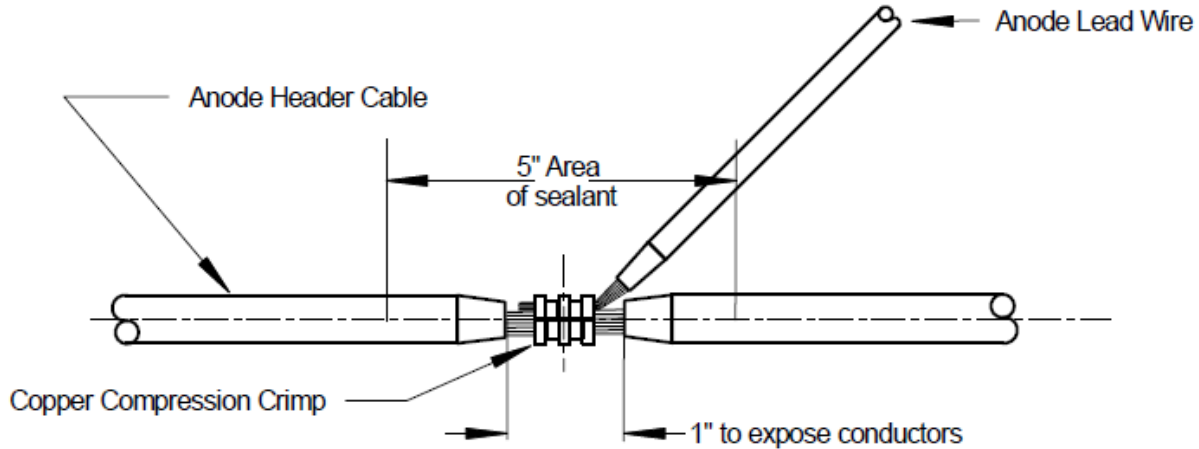




Plan View - Gate Valve



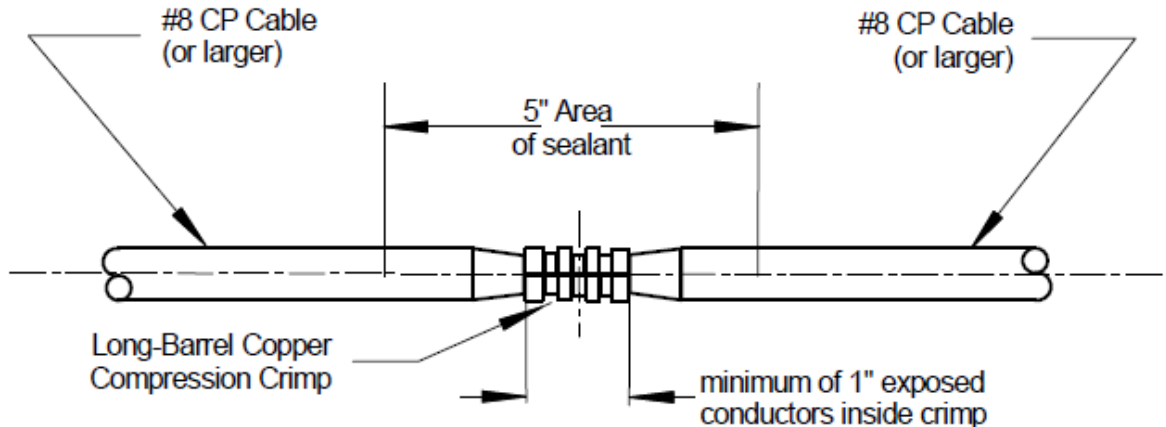
Plan View - Butterfly Valve

DRAWING NO. CP-321**INSULATING RUBBER & TAPE WYE SPLICE FOR SACRIFICIAL ANODE CABLE CONNECTIONS****Crimp Splice Procedure**

Remove approximately 1" of cable insulation to expose clean copper conductors. Join the conductors by inserting them equidistance into the compression connection sleeve. Crimp conductors firmly in place using a crimping tool that requires a complete crimp before the tool can be removed. A minimum of 2 equally-spaced crimp indents is required. Test the crimped connection by pulling on the cables.

Suggested Splice Sealing Procedure

Roughen the cable insulation 2" beyond the end of the exposed conductors. Ensure the entire surface over which the tape will be applied is clean using a lint-free cloth. Do not use solvents. Fill voids with insulating putty tape as required. Apply a high-voltage rubber tape half lapped over all bare conductors. Tape should be tensioned as recommended by the manufacturer. Half-lap tape to produce a uniform buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered approximately 1 inch over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Coat the entire tape wrap with a brush-applied electrical sealant.

DRAWING NO. CP-322**INSULATING RUBBER & TAPE BUTT SPLICE FOR SACRIFICIAL ANODE CABLE CONNECTIONS**

Note: "Splinting" the entire connection before burial to minimize wire stress is recommended.

Crimp Splice Procedure

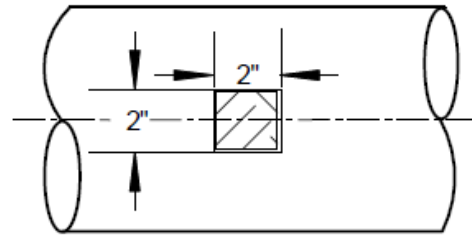
Remove at least 1" of cable insulation to expose clean copper conductors. Join the conductors by inserting them equidistance into the compression connection sleeve. Crimp conductors firmly in place using a crimping tool that requires a complete crimp before the tool can be removed. A minimum of 3 equally-spaced crimp indents is required. Test the crimped connection by pulling on the cables.

Suggested Splice Sealing Procedure

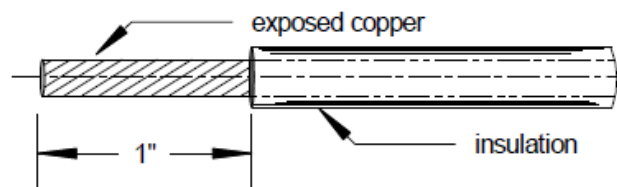
Roughen the cable insulation 2" beyond the end of the exposed conductors. Ensure the entire surface over which the tape will be applied is clean using a lint-free cloth. Do not use solvents. Fill voids with insulating putty tape as required. Apply a high-voltage rubber tape half lapped over all bare conductors. Tape should be tensioned as recommended by the manufacturer. Half-lap tape to produce a uniform buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered approximately 1 inch over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Coat the entire tape wrap with a brush-applied electrical sealant.

DRAWING NO. CP-401
EXOTHERMIC WELD PROCEDURE FOR FERROUS PIPE MATERIALS
(HORIZONTAL ONLY)

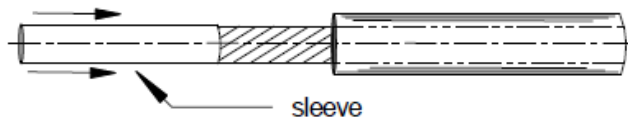
1. Clean a small square area at the top dead center of the pipe. Use a grinder or flat file to expose bright shiny metal.



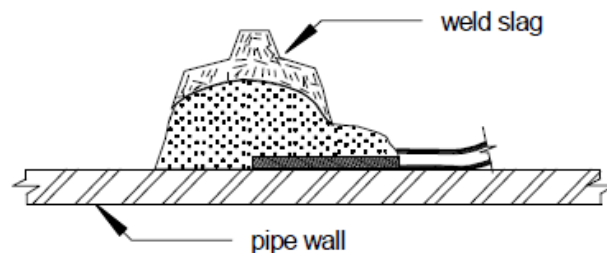
2. Strip off about 1" of insulation from stranded/solid copper wires or stranded copper cables.



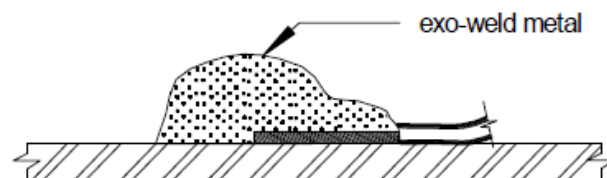
3. Slip on a copper weld sleeve to #10 AWG wire and smaller test wire and to #2 AWG or #4 AWG stranded copper bond cables.



4. Place the weld furnace directly over the copper wire or cable and while holding firmly in place, ignite flash powder with a flint igniter. After cooling, remove all slag from the top of the weld metal.

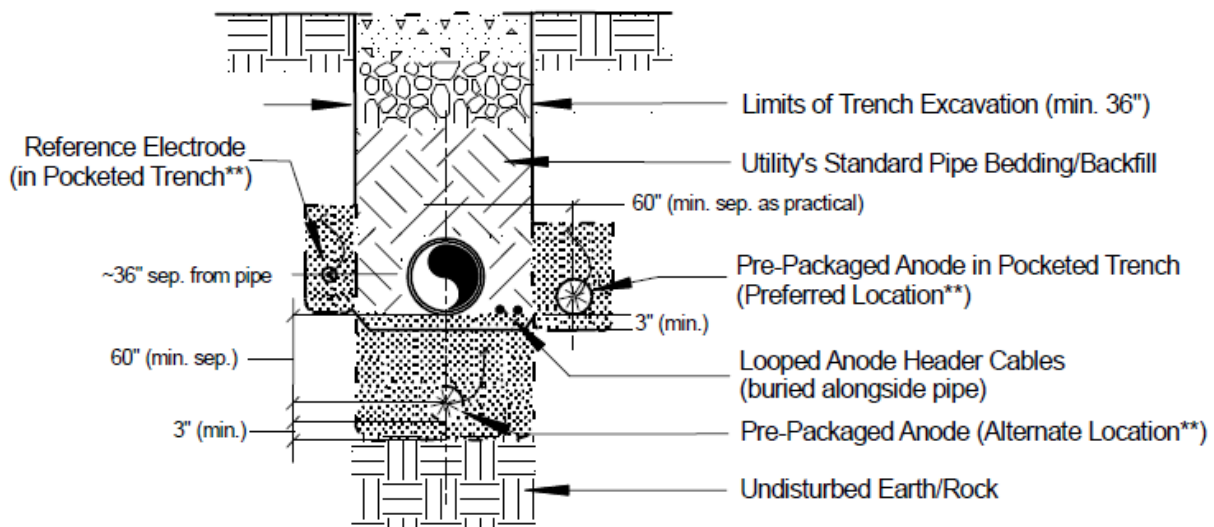


5. Apply cold-applied mastic/cap to cover all exposed copper and bare pipe metal prior to backfilling.

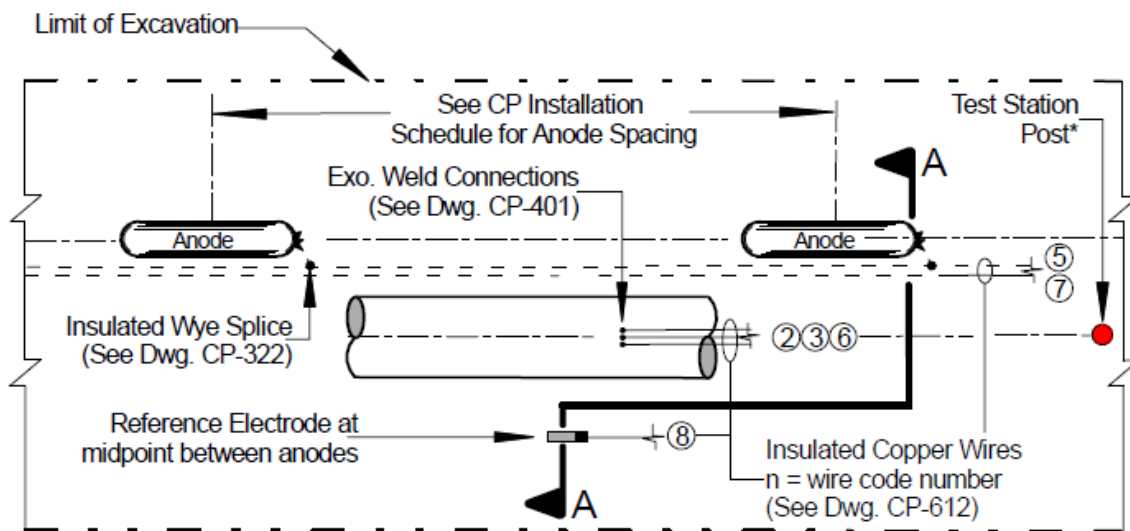


Do not use exothermic weld equipment if the graphite furnace is wet.
 Follow manufacturer's specific instructions for storage, handling, and use.

DRAWING NO. CP-611
ANODE TEST STATION (ATS)



Section A-A

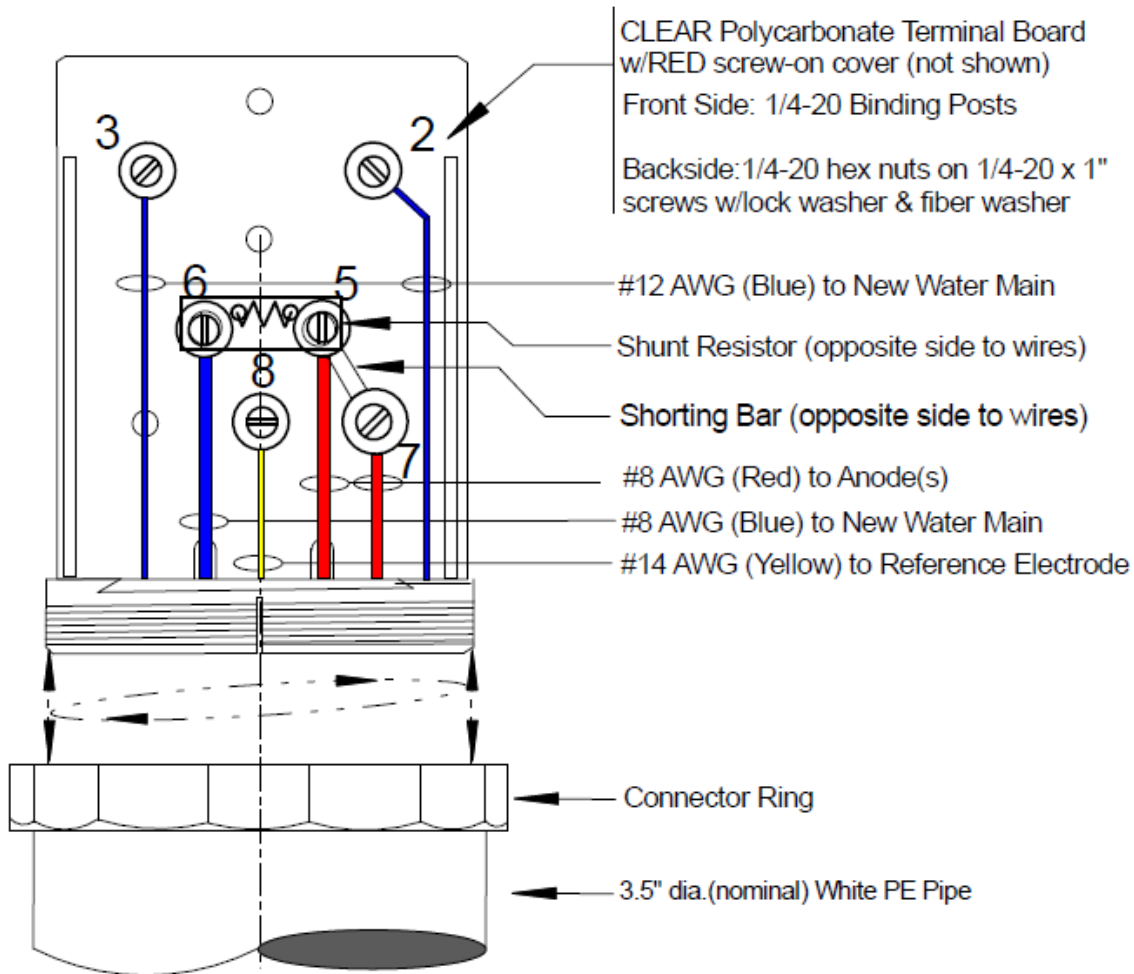


Plan View

**Backfilled with min. 12" Native Soil

* Install all test station types (specified as either post- or flush-type) within 35' of buried reference electrode

DRAWING NO. CP-612
ATS TERMINAL BOARD INSTALLATION DETAILS



Side 1: Wire and Cable Binding Post Connections

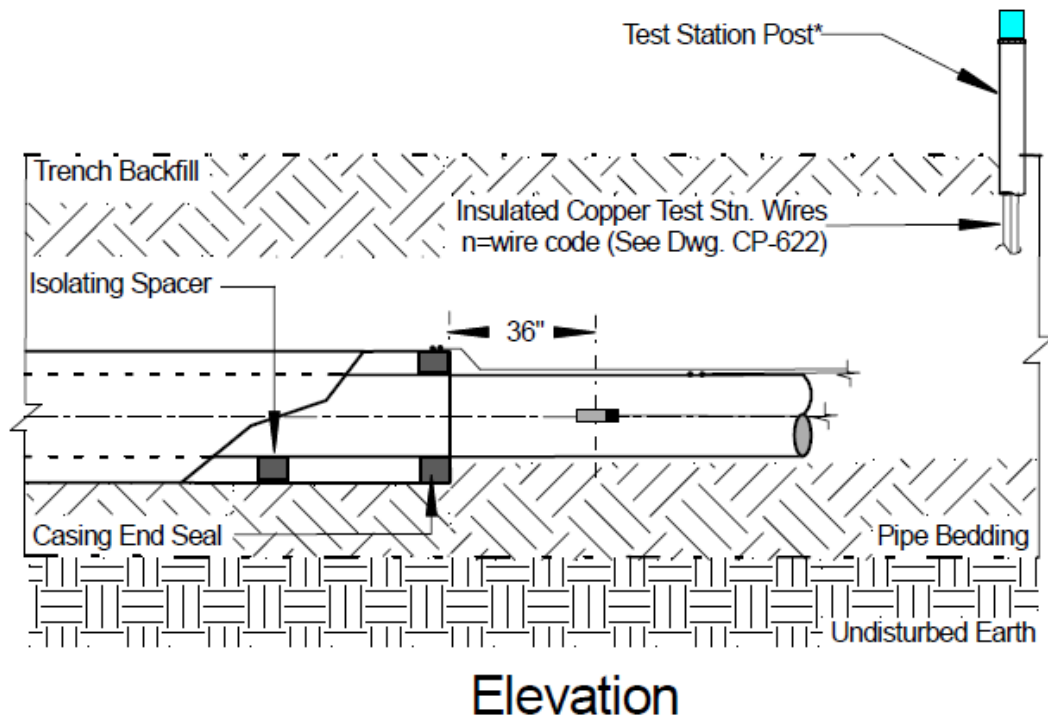


Side 2: Shunt & Shorting Bar Connections

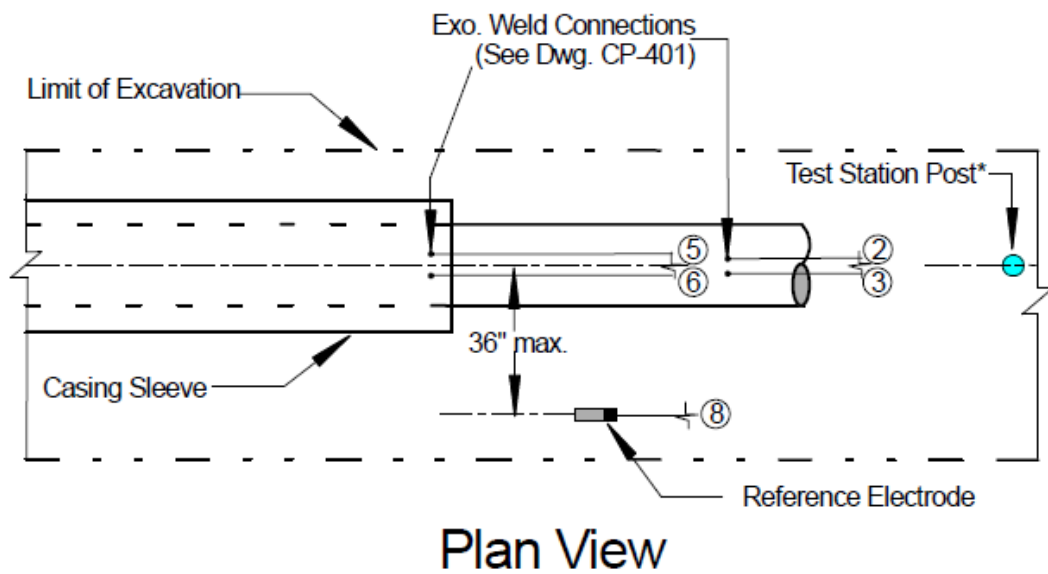


Terminal Board Cover Removed

DRAWING NO. CP-621
CASING TEST STATION (CTS)



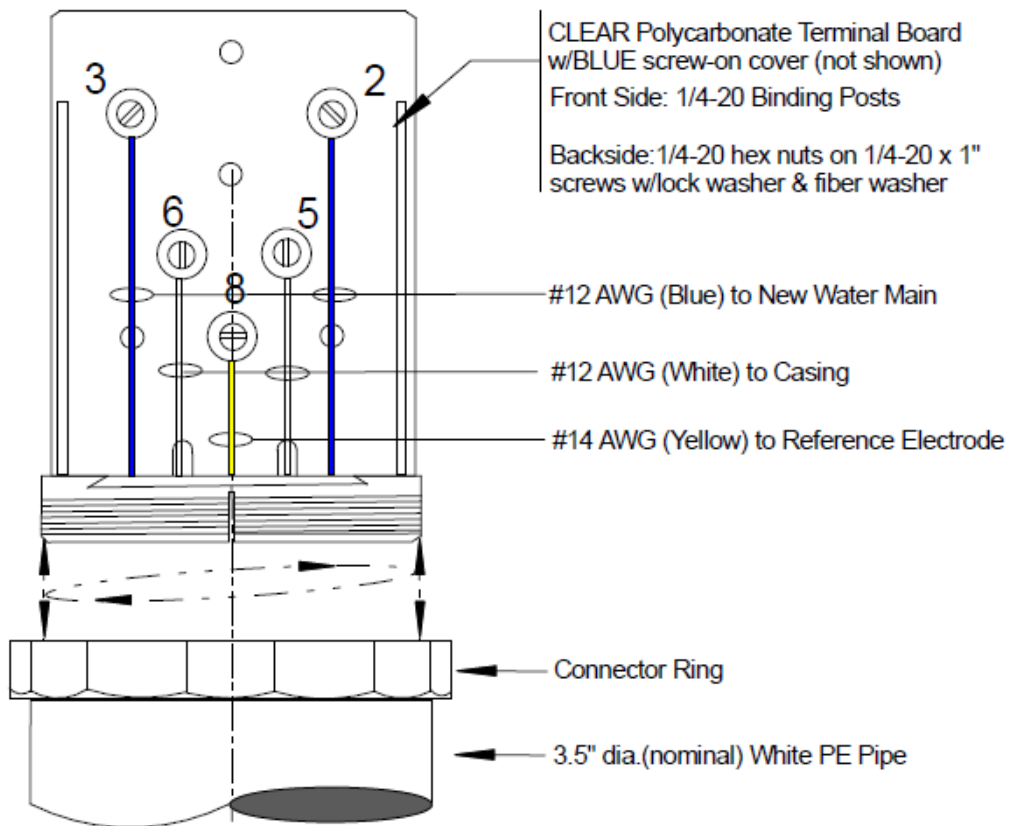
Elevation



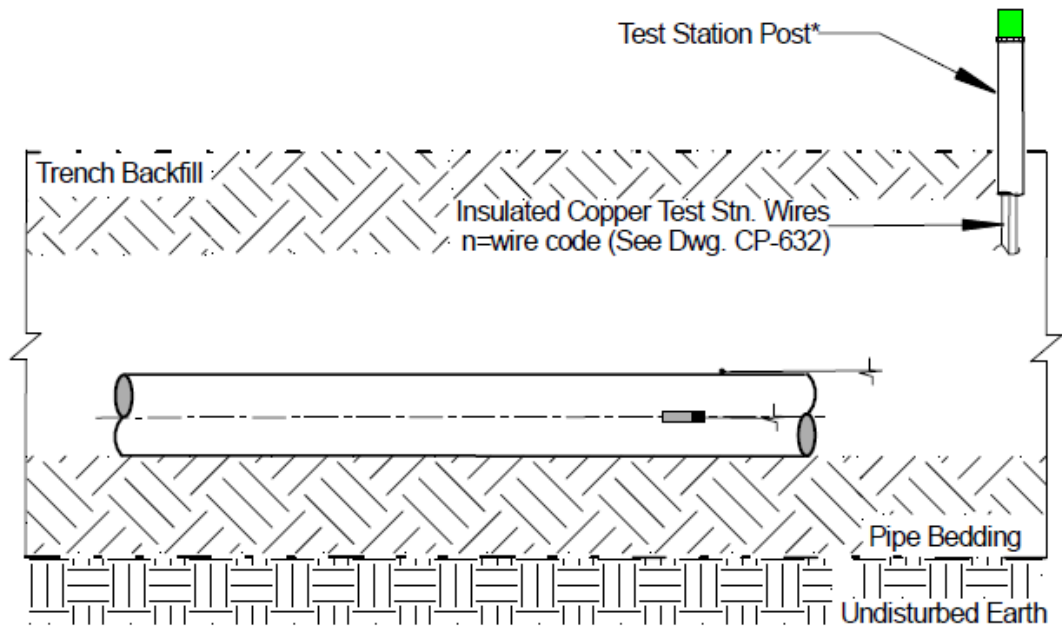
Plan View

* Install all test station types (specified as either post- or flush-type) within 35' of buried reference electrode

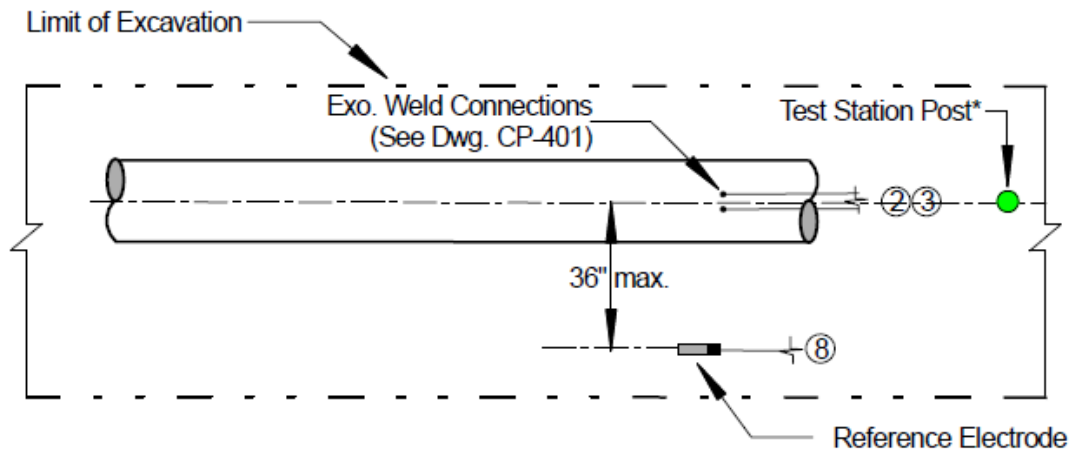
DRAWING NO. CP-622
CTS TERMINAL BOARD INSTALLATION DETAILS



DRAWING NO. CP-631
POTENTIAL TEST STATION (PTS)



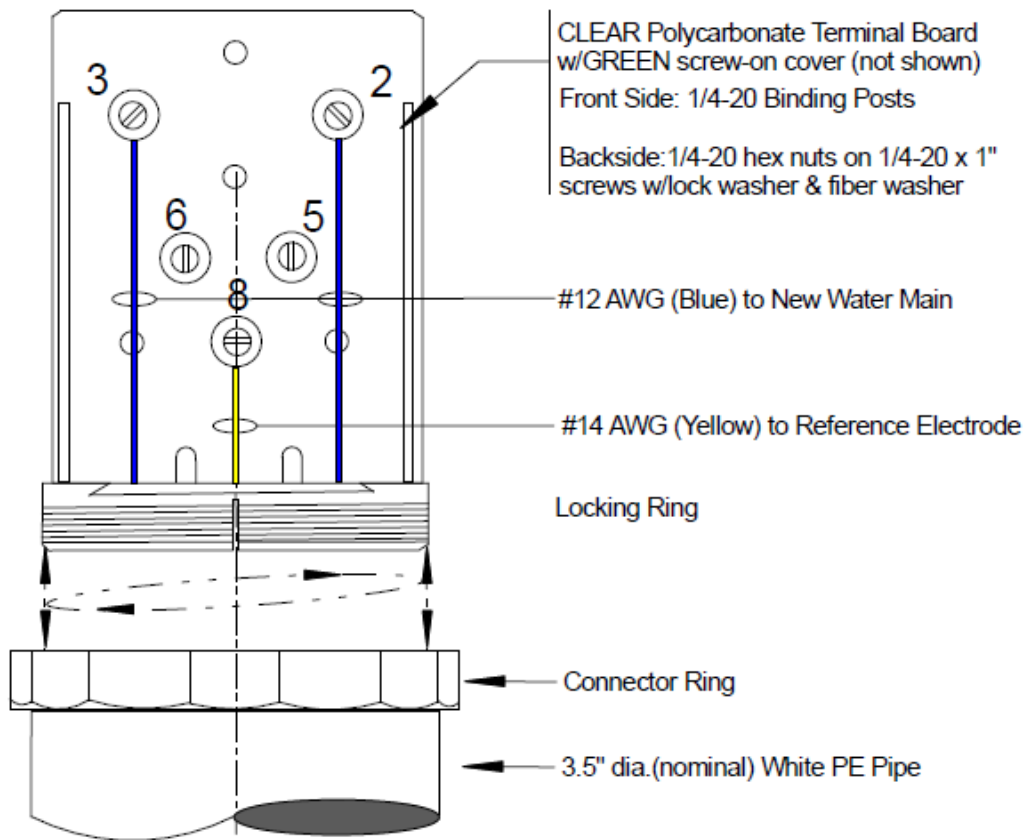
Elevation



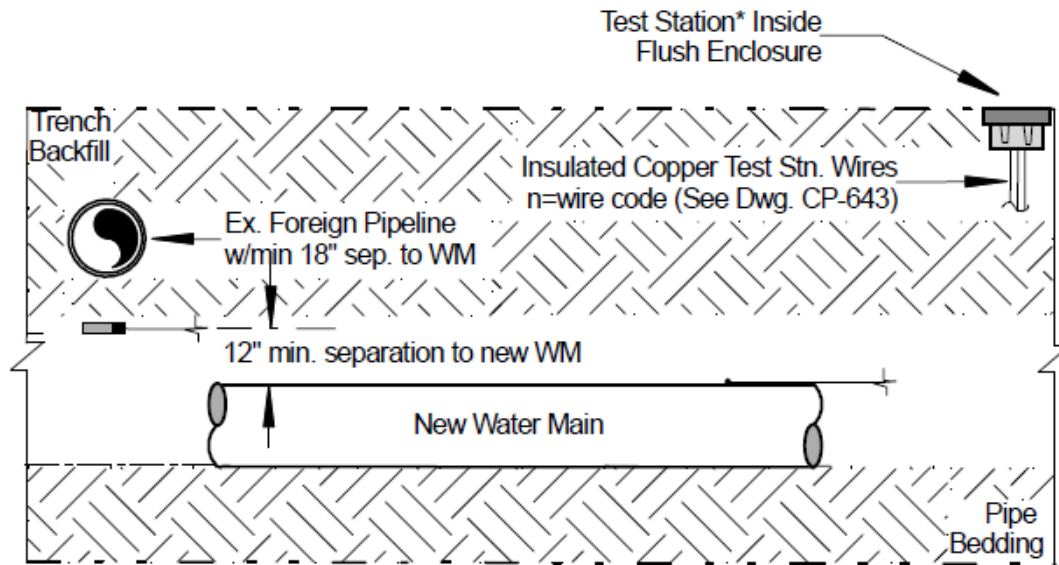
Plan View

* Install all test station types (specified as either post- or flush-type) within 35' of buried reference electrode

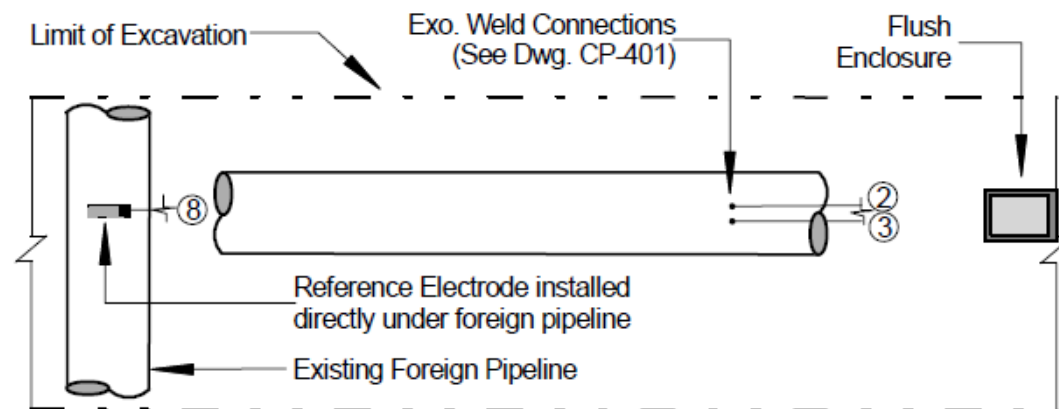
DRAWING NO. CP-632
PTS TERMINAL BOARD INSTALLATION DETAILS



DRAWING NO. CP-641
FOREIGN CROSSING (OVER WM) TEST STATION (FTS)



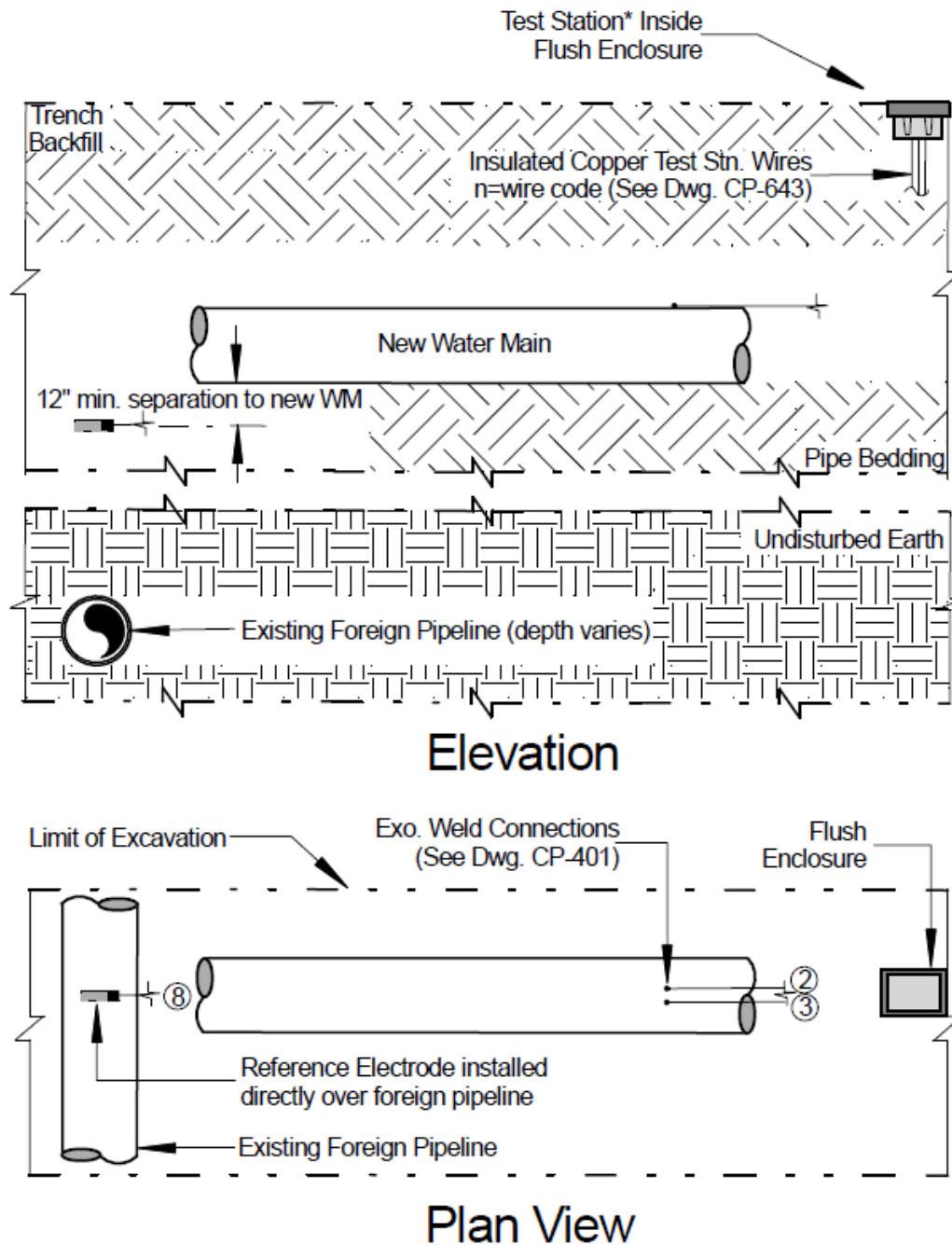
Elevation



Plan View

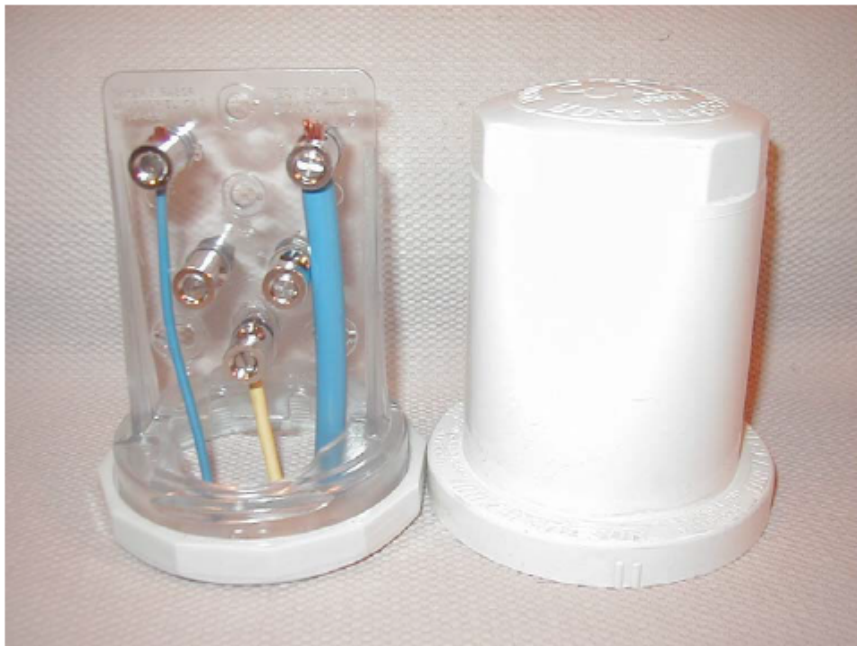
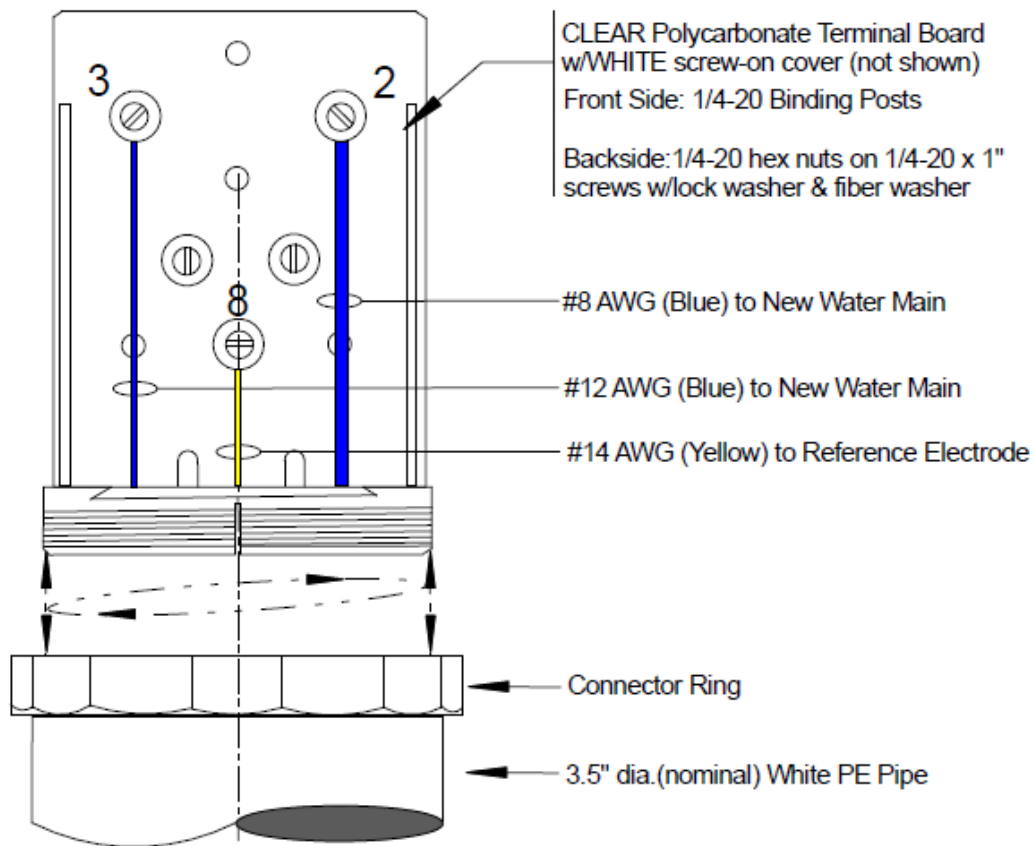
* Install flush test station enclosure within 35' of buried reference electrode

DRAWING NO. CP-642
FOREIGN CROSSING (UNDER WM) TEST STATION (FTS)

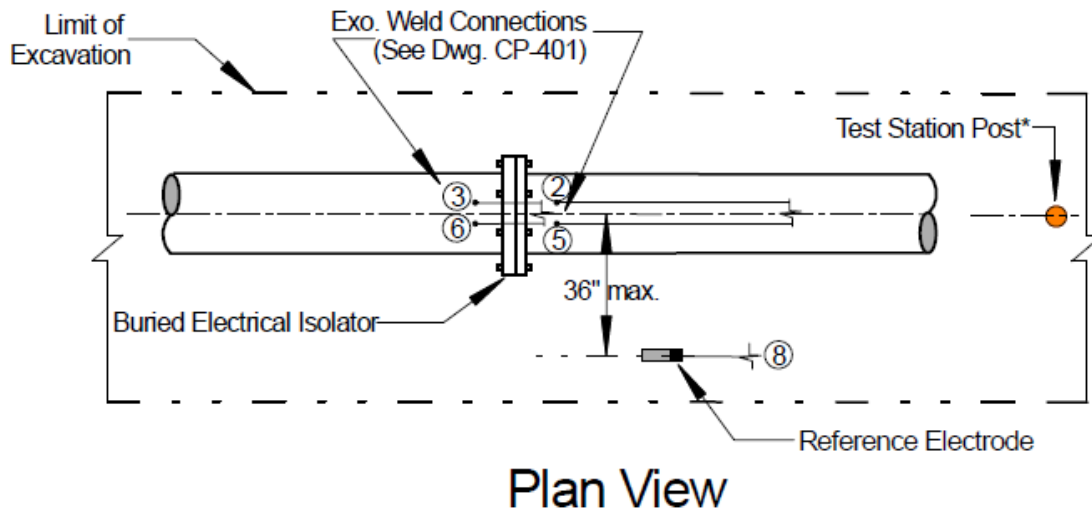
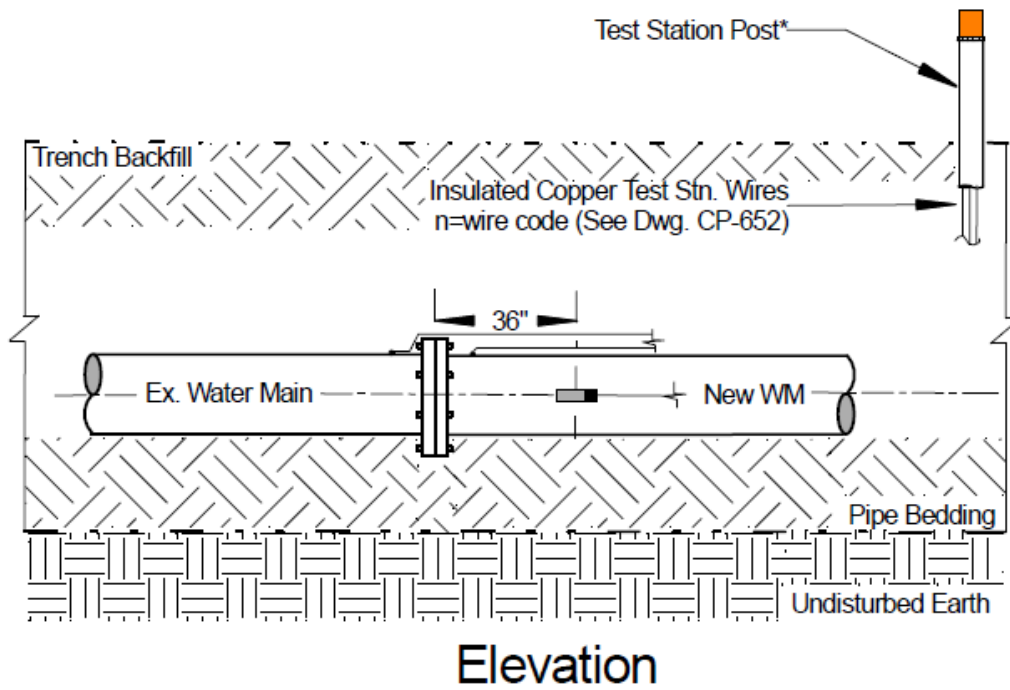


* Install flush test station enclosure within 35' of buried reference electrode

DRAWING NO. CP-643
FTS TERMINAL BOARD INSTALLATION DETAILS

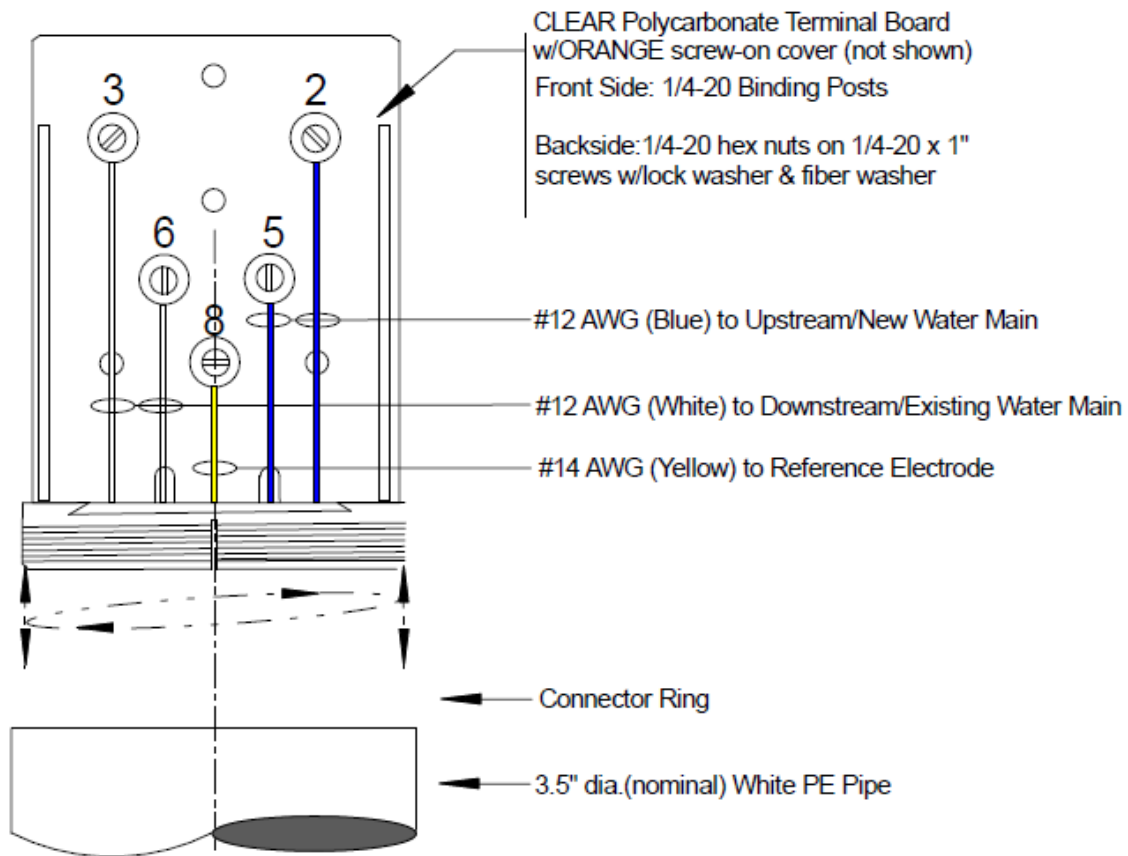


DRAWING NO. CP-651
ISOLATION TEST STATION (ITS)



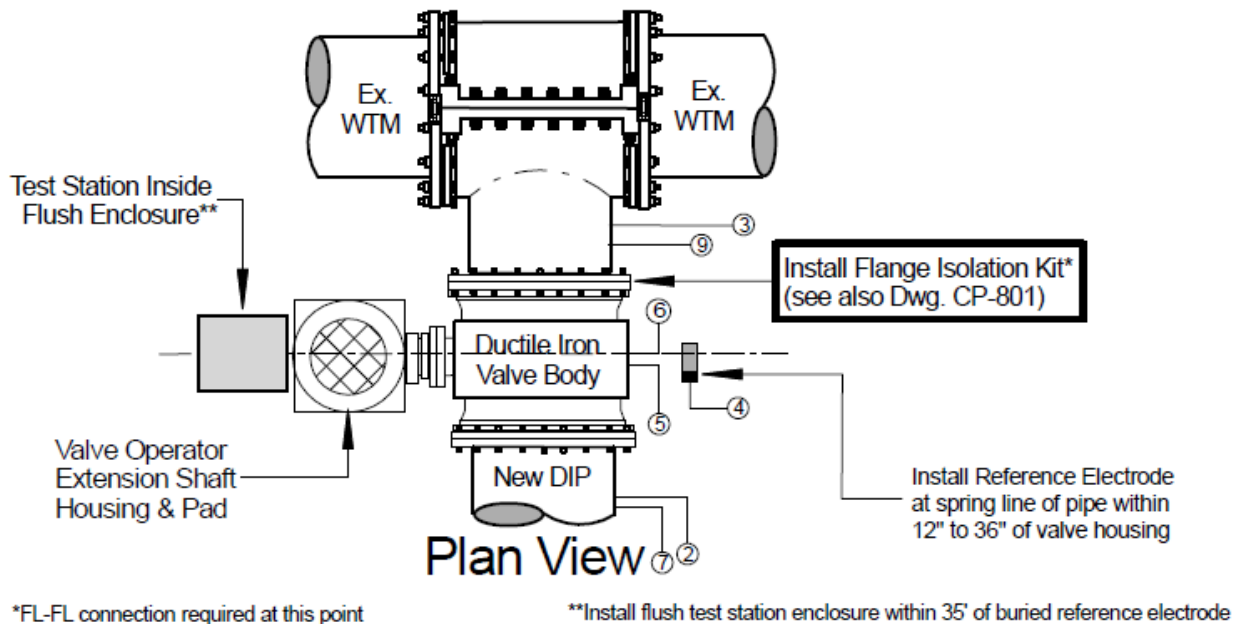
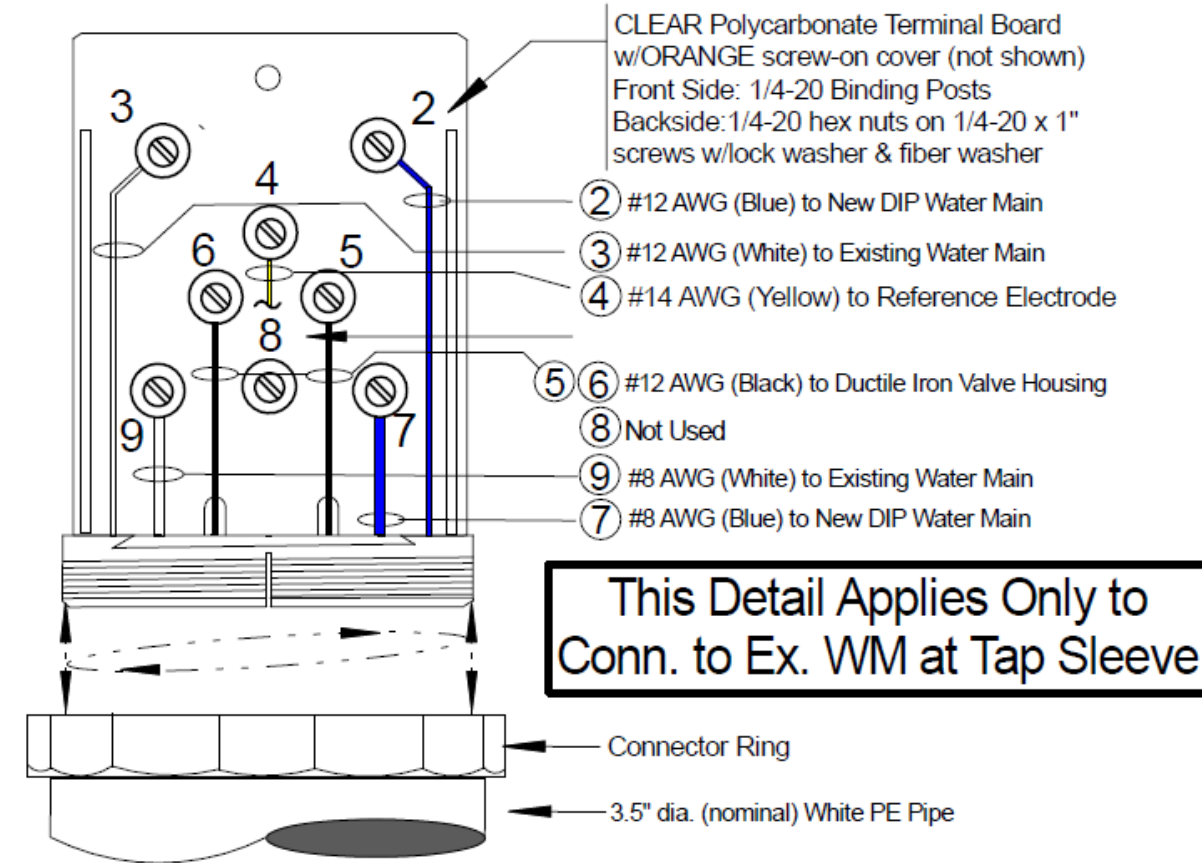
* Install all test station types (specified as either post- or flush-type) within 35' of buried reference electrode

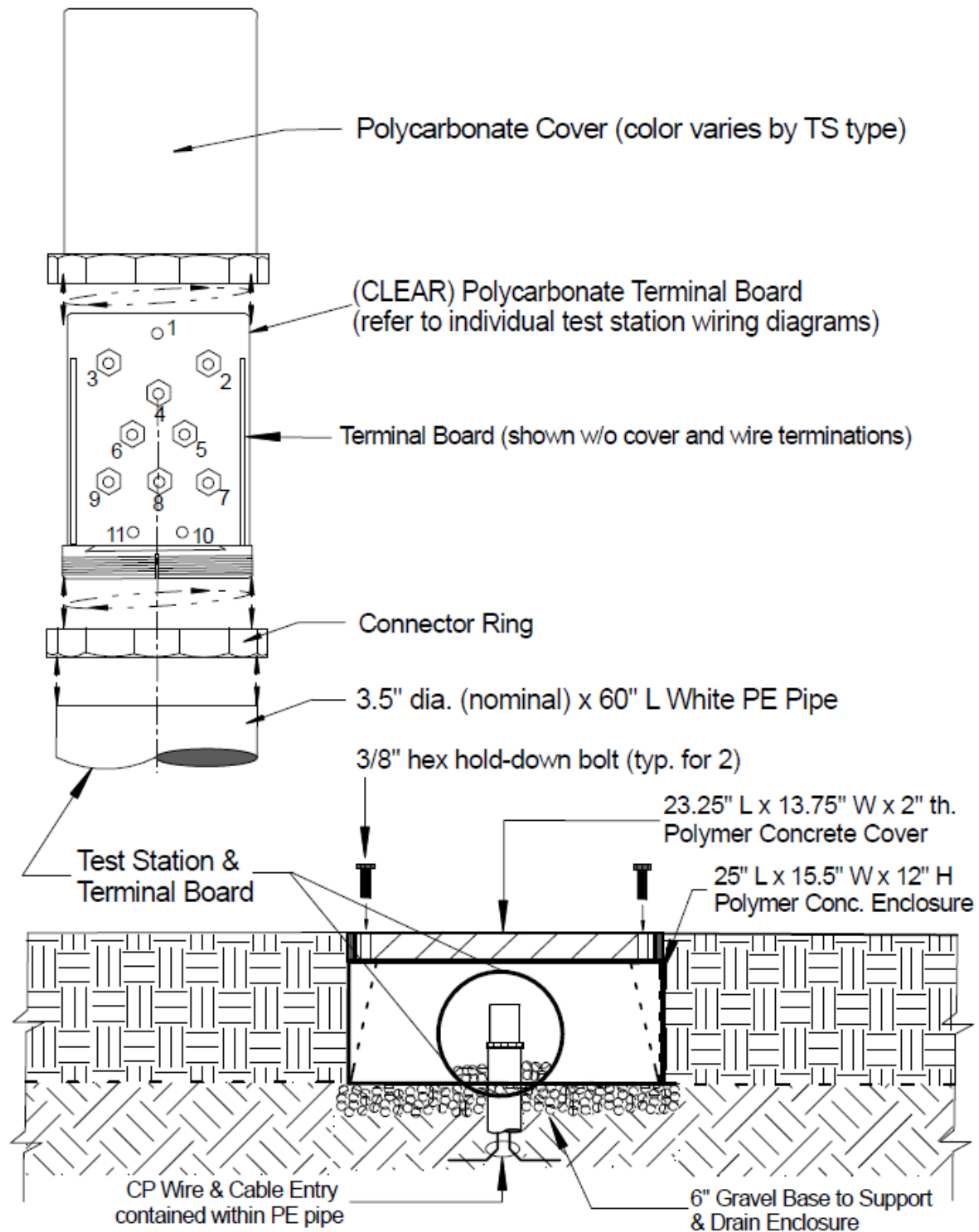
DRAWING NO. CP-652
ITS TERMINAL BOARD INSTALLATION DETAILS



DRAWING NO. CP-653

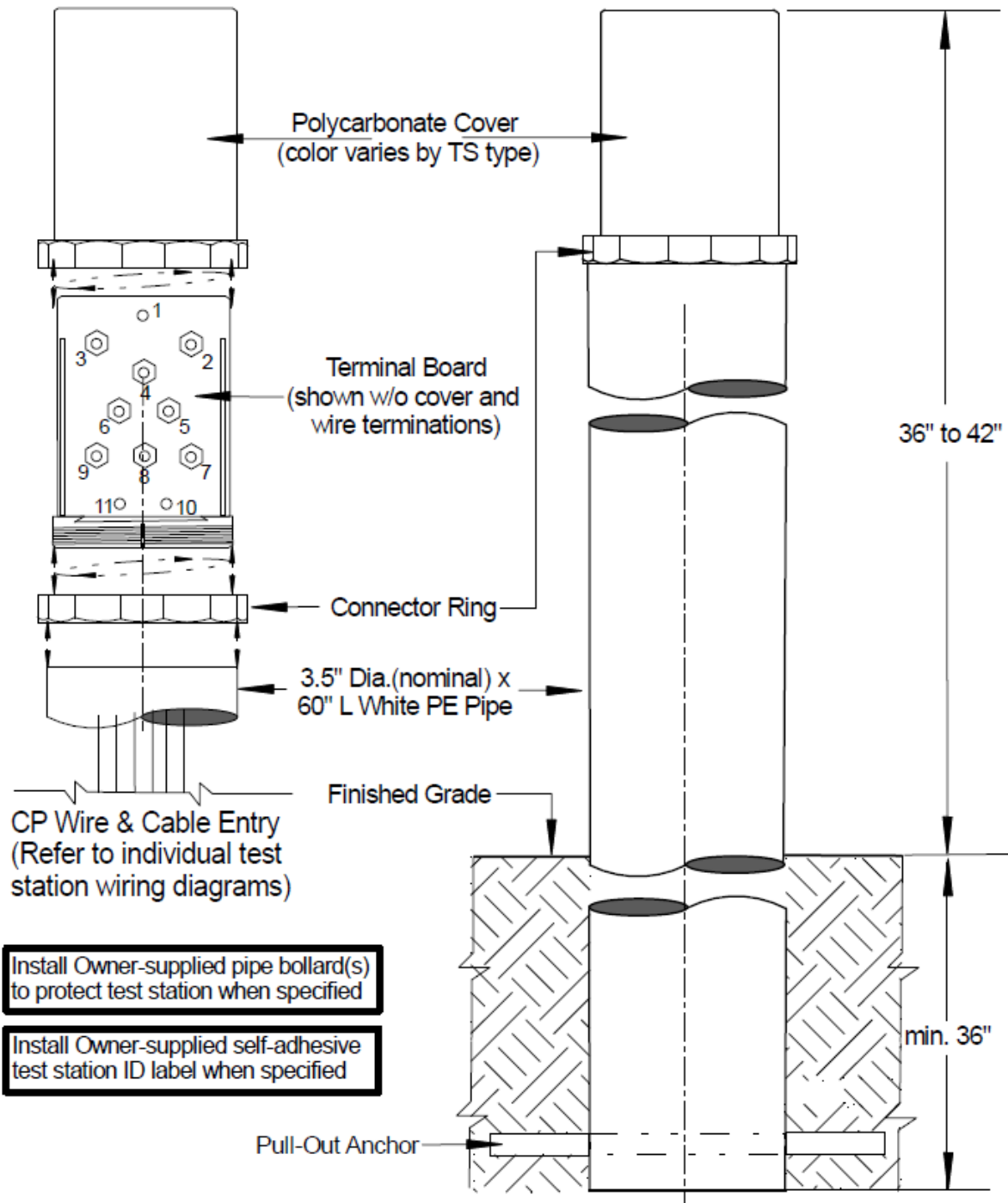
ISOLATION TEST STATION AT TAPPING SLEEVE (ITS-TAP)



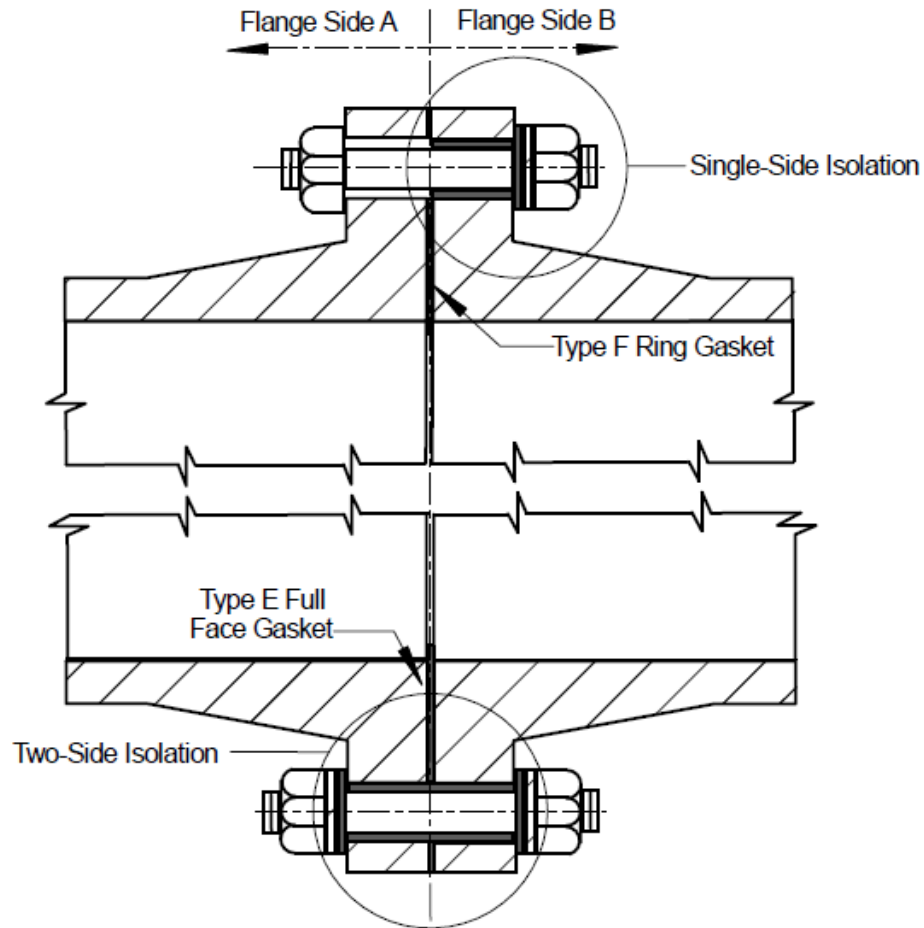


DRAWING NO. CP-692

POST-MOUNTED TEST STATION FOR TERMINAL BOARD & WIRES



DRAWING NO. CP-801
FLANGE ISOLATION KIT (FIK)

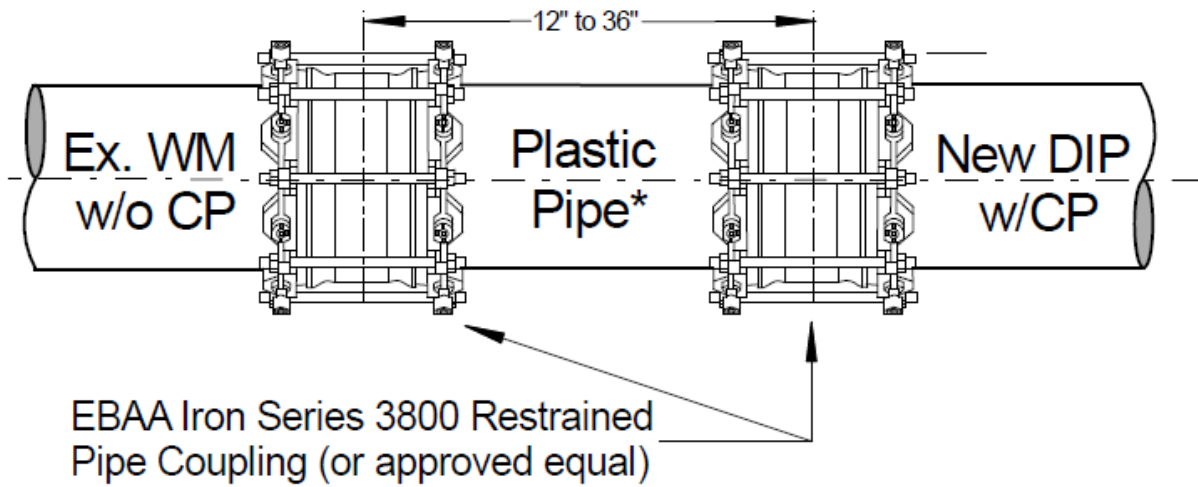


Note: ANSI-AWWA companion flanges are required. FIK cannot be installed on M.J. joints.

Required Information to Properly Size a Flange Isolation Kit

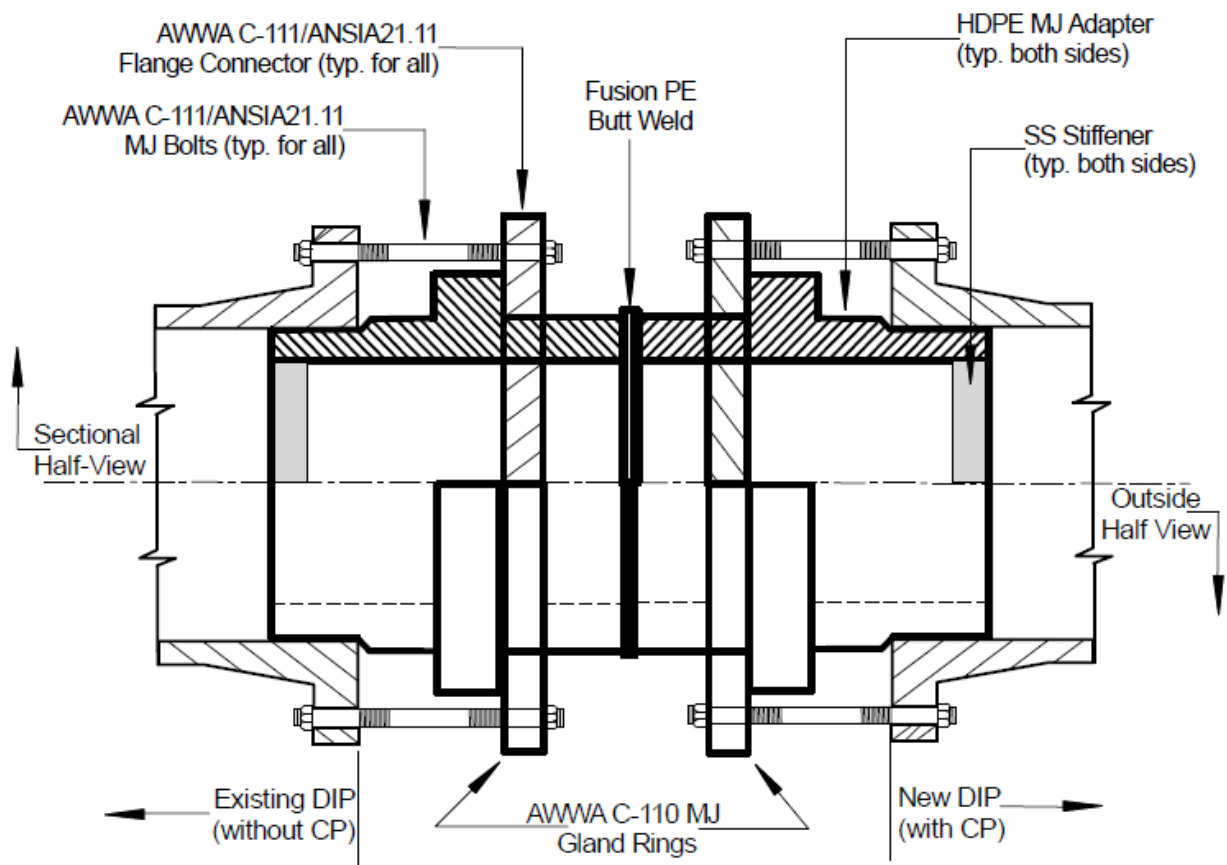
Flange Spec.	_____
Flange Size	_____
Flange Rating	_____
Flange O.D.	_____
Flange I.D.	_____
Bolt Circle Ø	_____
Qty. Bolt Holes	_____
Flange Bolt Ø	_____
Bolt Hole Ø	_____
Flange Thickness (A)	_____
Flange Thickness (B)	_____

DRAWING NO. CP-804
POLYVINYL CHLORIDE PIPE INSERT (PVPI)



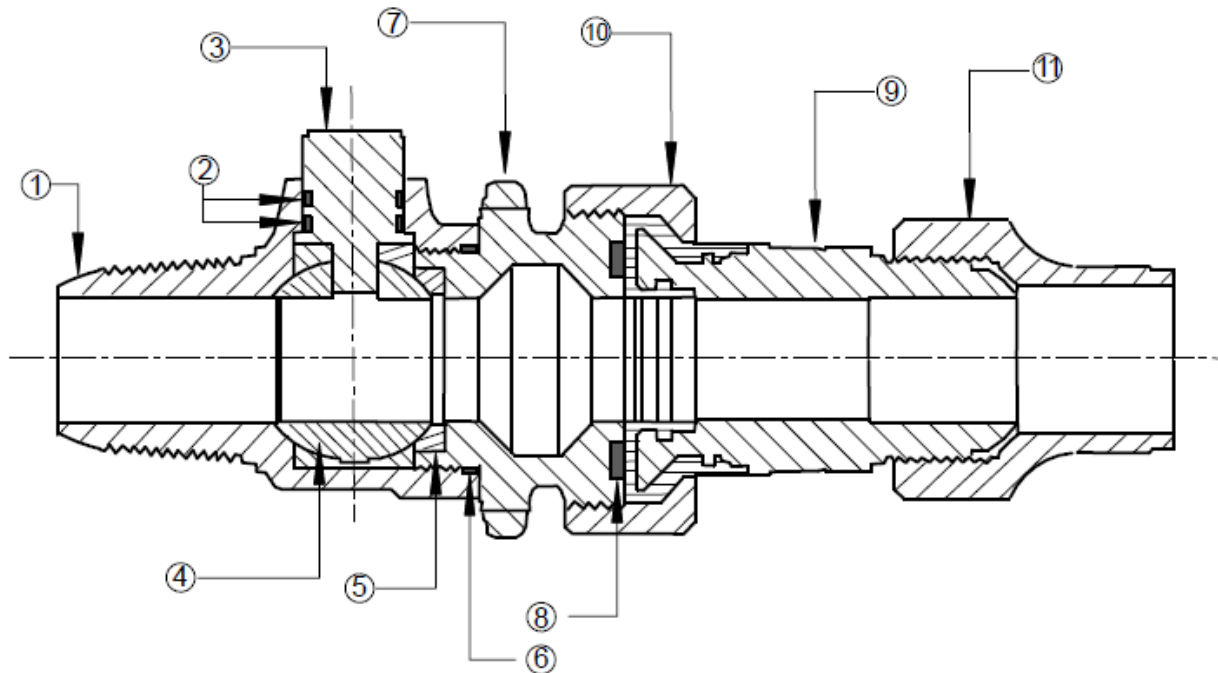
Nominal Pipe Size (in.)	PVC Pipe Specification*	
	C900 PVC	C905 PVC
Minimum	4	14
Maximum	12	24

DRAWING NO. CP-805
HIGH DENSITY POLYETHYLENE PIPE INSERT (HDPI)

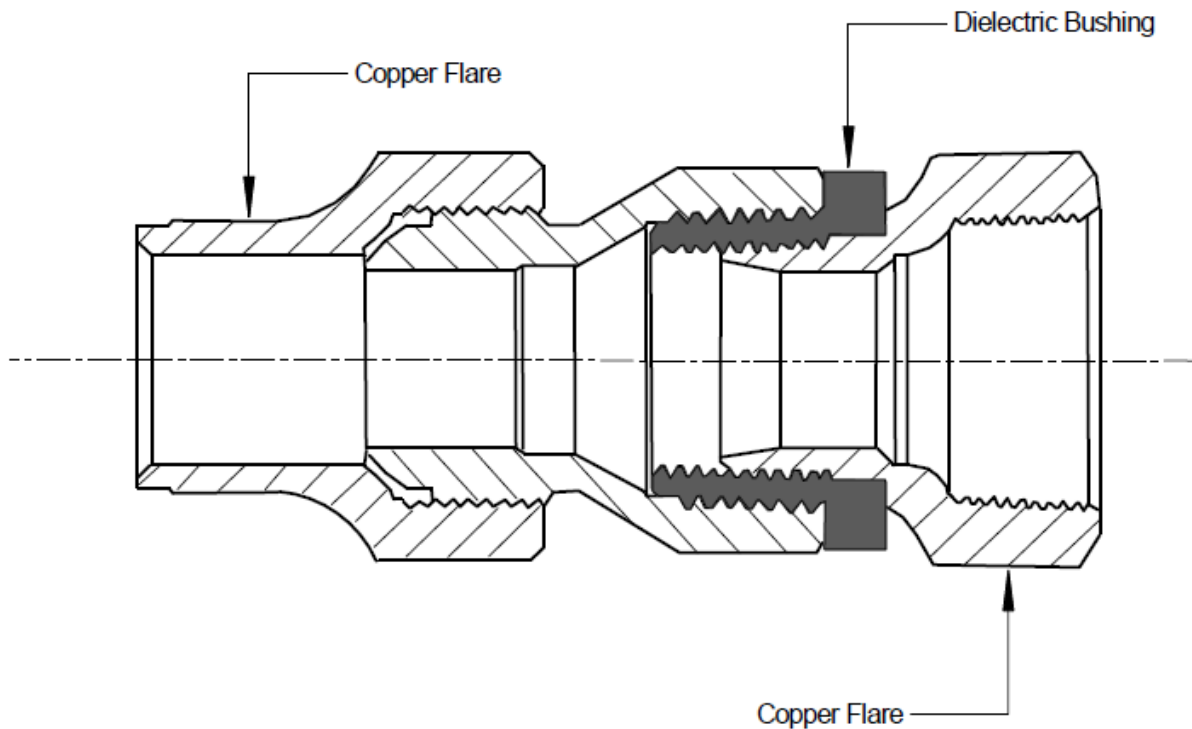


DRAWING NO. CP-806
ISOLATION (BALL TYPE) CORPORATION STOP (ICS)

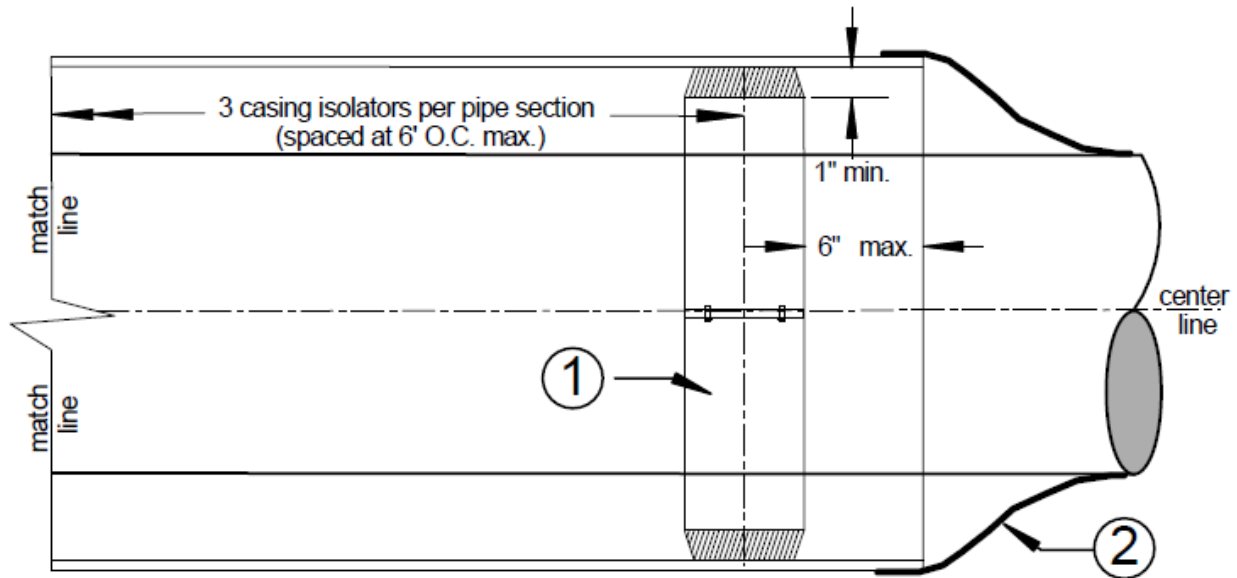
COMPONENT LIST FOR BALL CORP VALVE LLB ASSEMBLY CC X CS				
MARK	DESCRIPTION	MATERIAL	ASTM	ALLOY or TYPE
1	BODY	BRASS	CAST LOW LEAD ALLOY	
2	D-RING	RUBBER	D-2000	EP
3	STEM	BRASS	CAST LOW LEAD ALLOY	
4	BALL	BRASS	CAST LOW LEAD ALLOY	
5	GASKET	RUBBER	D-2000	NITRILE
6	D-RING	RUBBER	D-2000	EP
7	END PIECE	BRASS	CAST LOW LEAD ALLOY	
8	D-RING	RUBBER	D-2000	NITRILE
9	INSULATED TAIL PC.	BRASS w/NYLON	CAST LOW LEAD ALLOY	
10	COUP. NUT	BRASS	B-62	ALLOY C83600
11	TUBE NUT	BRASS	B-62	ALLOY C83600
MUELLER MODEL N35000N SHOWN (other models are similar)				



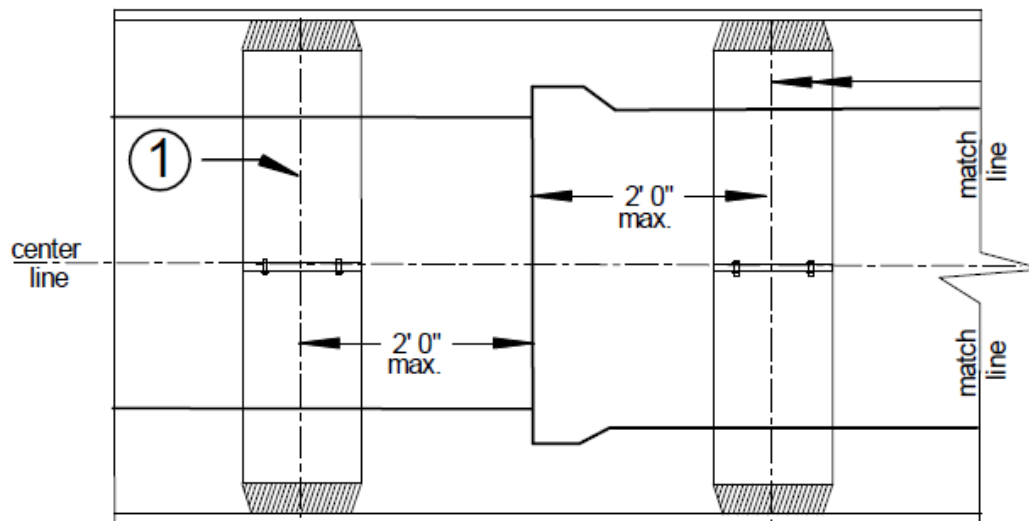
Follow the manufacturer's installation instructions.
Do NOT to tighten across the dielectric bushing.
NOTE: These fittings are NOT field serviceable.



A.Y. McDonald Model 747-55DB Shown (other manufacturers' products are similar)



Casing Isolator and Casing End Seal



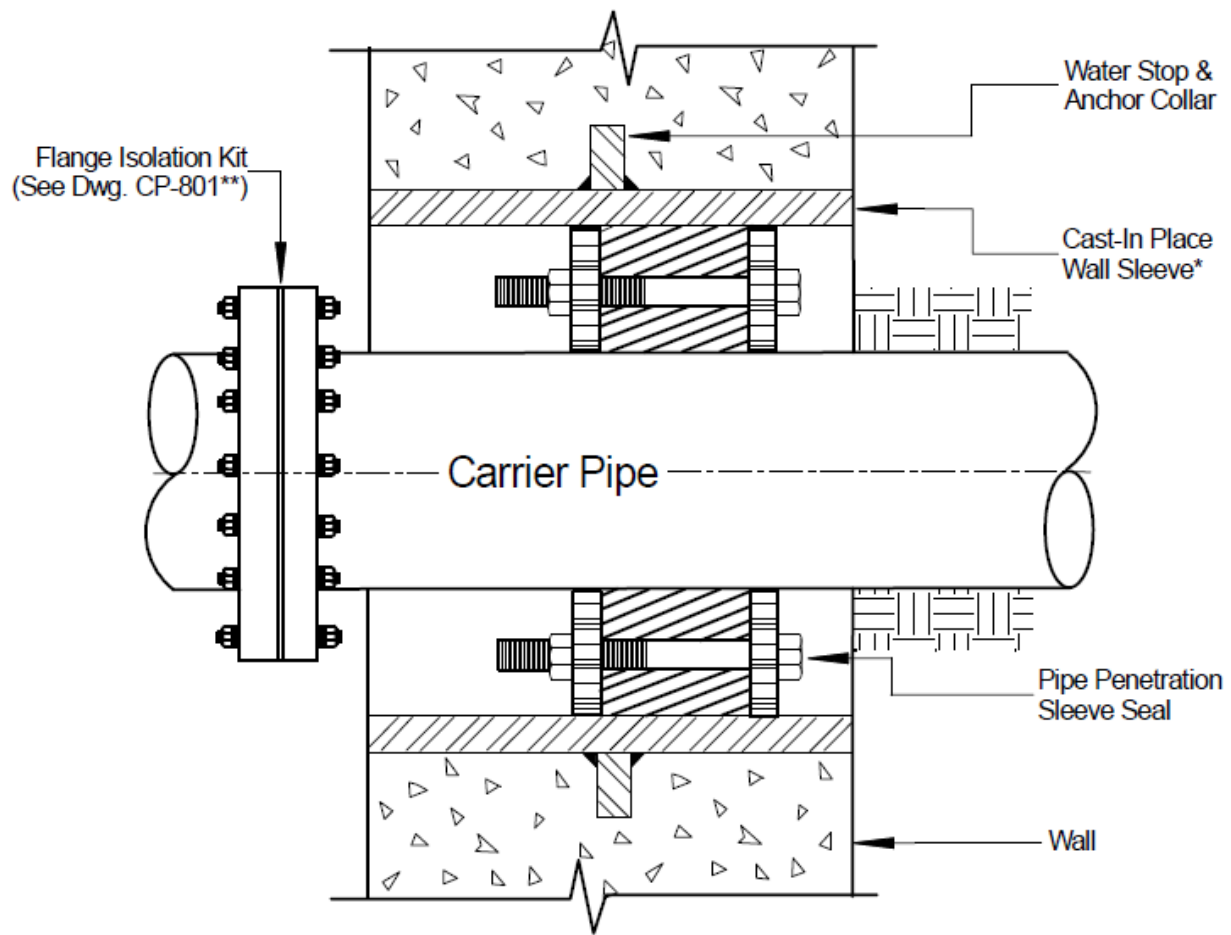
Casing Isolators Installed at Pipe Joint

- ① Stainless Steel Band Casing Isolator w/Dielectric Runners
- ② Wrap-Around Casing Boot End Seal (pipe not req'd to be centered)

Note: Ductile Iron Pipe is shown - casing isolators for welded steel pipe are similar

DRAWING NO. CP-809

ELECTRICAL ISOLATION AT PIPE ENTRY WITHIN REINFORCED CONCRETE WALL



* Wall may be cored as an alternative to using wall sleeve

** Do not ground pipe between FIK and wall

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 24

TRAFFIC SIGNALS, ITS AND LIGHTING

ARTICLE	TITLE	
24.00	GENERAL	2403
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	B. QUALIFIED PERSONNEL	2403
	C. MATERIAL TESTS	2403
	D. ELECTRICAL SERVICE APPLICATIONS	2404
	E. CITY FURNISHED MATERIALS	2404
	F. EXCAVATION AND BACKFILL	2405
	G. CONTRACTOR RESPONSIBILITY	2405
	H. GRADES	2405
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	J. DOWNTIME FOR TRAFFIC SIGNALS OR STREET LIGHTING	2407
	K. ENERGIZING OR DE-ENERGIZING TRAFFIC SIGNALS	2408
	L. ANTI-SEIZE COMPOUND	2408
	M. SUBSTANTIAL COMPLETION	2408
	N. INSPECTION COMPLETION	2409
	O. SIGNAL SUPPORT SPAN	2409
24.01	REMOVE OR RELOCATE OR ADJUST	2410
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	B. BASIS OF PAYMENT	2410
24.02	TEMPORARY TRAFFIC SIGNAL	2411
	A. GENERAL	2411
	B. BASIS OF PAYMENT	2411
24.03	CONDUIT	2412
	A. GENERAL	2412
	B. INSTALLATION	2412
	C. CONDUIT BORED	2413
	D. CONDUIT IN TRENCH	2414
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	B. INSTALLATION	2415
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CHAPTER 24

TRAFFIC SIGNALS, ITS AND LIGHTING

24.00 GENERAL

A. STANDARDS

Where NEMA Specifications are established, all electrical equipment shall conform to the standards of National Electrical Manufacturers Association (NEMA). In addition to the requirements of these Standard Specifications and the plans, all material and Work shall conform to the Standard Specifications of the following organizations: National Electric Safety Code (NESC); American Society for Testing and Materials (ASTM); American Standards Association (ASA); International Municipal Signal Association, Inc. (IMSA); Insulated Cable Engineers Association (ICEA); American Institute of Steel Construction (AISC); American Association of State Highway and Transportation Officials (AASHTO); Manual on Uniform Traffic Control Devices (MUTCD); and the ordinances of the City of Lincoln (City), insofar as they apply. Wherever reference is made in the Standard Specifications to the standard mentioned above, the reference shall be construed to mean the code or standard that is in effect on the date of advertising of the contract document.

Traffic Signal Poles shall reflect the 1994 AASHTO guidelines for pole design.

B. QUALIFIED PERSONNEL

A certified and qualified journeyman lineman shall be on the job site to supervise pulling of fiber, splicing of wire where permitted, and to perform the task of final connections in all signal indications, push buttons, detectors, cameras, dynamic message signs, and cabinets. The Contractor shall be IMSA Traffic Signal Construction Technician Level II certified. All workers on the job site shall have Work Zone Temporary Traffic Control certification. Proof of certification or license of individuals on job site shall be required at the pre-construction meeting.

C. MATERIAL TESTS

When any reference is made in the Standard Specifications to a standard, such as ASTM, ICEA, IMSA, etc., or a related Specification referred to by reference therein, which states that a certain test is to be made only at the request of the purchaser, it shall be considered that the City does request that such test be made. The tests shall be made at the Contractor's expense and a certified copy of each test shall be submitted to the City's Project Manager prior to the installation of such material.

Traffic Signal and/or Street Lighting poles require shop drawings and Manufacturer's certification of compliance. In the case of wood poles, the type, size, treatment, or certain unspecified situations shall require that in addition to the above, the Contractor furnish mill test data or design calculations.

The Contractor shall submit to the City's Project Manager 1 hard copy and 1 electronic (pdf) copy of a complete list of all equipment and materials they intend to install. Catalog cuts and/or Manufacturers model number shall be required for the materials furnished by the Contractor and incorporated into the project. There shall be no substitutes for any of the items on the list without prior written approval of the City's Project Manager.

D. ELECTRICAL SERVICE APPLICATIONS

The Contractor shall make arrangements with Lincoln Electric System (LES) for power service. Any delay resulting from a Contractor's untimely request to the local utility for power service shall not be justification for the suspension or extension of the working days or calendar days on a project. Electrical services at the locations shown on the plans have been previously agreed to by the City and the Utility. The locations of all such services are subject to minor revisions in the field in order to adapt field requirements as may be determined by the Utility and the City's Project Manager.

E. CITY FURNISHED MATERIALS

The Work covered in this chapter shall include the furnishing of certain materials and equipment and the installation of all necessary materials and equipment to provide a traffic signal and/or a street light installation complete, in place and ready for operation; and/or the modification, removal or salvage of existing traffic signal and/or street light components or systems; in conformance with the plans and these Standard Specifications. When the item is furnished by the City the item of payment is prefaced by the word, "Install".

Furnished Traffic Signal Materials shall be picked up at Traffic Operations storage locations between 8:00 a.m. to 3:00 p.m. weekdays with 24-hour notice, with the exception of city holidays. Furnished Street Lighting materials shall be picked up at LES Storeroom at the Walter Canney Service Center at 27th and Fairfield Streets, between 7:30 a.m. to 4:00 p.m. weekdays, with the exception of holidays. Further direction may be required either by Special Provision or by the City's Project Manager. Refer to Section IV; "Control of Materials", Subsection E. "Materials Supplied By The City" of the General Provisions and Requirements for procedures to be followed in handling City-furnished materials and/or equipment.

The Contractor shall be responsible for all material or equipment furnished by the City from the time that it is picked up to the completion of work. The costs of damaged materials shall be deducted from the final payment.

The contractor shall take all precautions to protect the cabinet from damage including any concrete splatters, dents, scratches or any other damage as noted by the City's Project Manager. In the event of damage to the cabinet, the contractor shall remove the damaged cabinet and re-wire a new cabinet supplied by the City. The cost of the damaged cabinet shall be deducted from the final payment.

City traffic signal personnel shall be responsible for bench testing traffic signal cabinets to be installed by the Contractor, and shall field test each installed traffic signal cabinet prior to turn on. All other activities associated with the installation, including but not limited to, labor, materials, tools, and transportation are the responsibility of the Contractor.

The Contractor shall furnish all other materials, including, but not limited to concrete, epoxy coated reinforcing steel, conduit, pull boxes, cable, splice kits, messenger cable and hardware, pole clamps and hardware, risers, down guys, ground rods and clamps, traffic signal poles, street light poles, luminaires, and all other miscellaneous materials and/or hardware necessary to complete the Work in conformance with the Plans, Standard Specifications, or the Special Provisions.

24.00 GENERAL (Continued)

F. EXCAVATION AND BACKFILL

Excavation for trenches, pull boxes or foundation removal shall be backfilled and compacted daily unless properly protected. All trenches for burial of electrical cable and conduit shall not exceed 6" in width.

All excavations shall be backfilled within 48 hours of excavation.

The first 4" of backfill for trenches shall consist of finely pulverized earth and shall contain no broken glass, rocks, or other sharp material that might damage the cable.

The remainder of the backfill material will normally be earth excavated from the trench unless such earth is water saturated or frozen. Backfill material shall be substantially dry, loose, clean earth free from rocks and debris. Excessively dry or excessively sandy material is not permitted.

Before backfilling, all standing water shall be removed from the trench. Tamping shall be done at no more than 12" backfill level intervals to ensure proper compaction throughout the depth of the void. The foot of the compressed air or hydraulic tamper to be used to compact the backfill shall be sized in conformance with the width of the trench. Hand tamping is not permitted. All excess backfill material shall be removed from the site within 48 hours.

G. CONTRACTOR RESPONSIBILITY

The Contractor is responsible to inform the City's Project Manager of any defect found in the existing electrical or communications systems. Such defects may include, but not be limited to existing improper splices or existing damaged cable or existing damaged conduit. The City's Project Manager and Contractor shall determine a plan and cost to correct said defect.

The Contractor is responsible to locate the signal system within the project area, until the final inspection is complete.

H. GRADES

All work shall conform to line, elevation and grade as shown on the plans. If no grades are shown on the plans, the longitudinal grade for the improvement shall be the same as the grade of the top of the existing curb. If there is no curb, the longitudinal grade shall be considered as a straight line between points where elevations are shown on the plans.

The elevation of top of pull box and top of pole foundation shall be established according to conditions below. The elevation of the top of Cabinet Base shall be 3" above the grade listed unless the Cabinet Base is in the sidewalk, in which case it shall be at grade.

1. Existing curb with no sidewalk: The grade shall slope upward from the top of the back edge of the curb at the rate of 2%.
2. Existing curb with sidewalk: The grade shall be a straight line from the top of the back edge of the curb to the top of the curbside of the sidewalk.
3. Existing curb with adjoining sidewalk: The grade shall be the same as the grade of the top of the sidewalk.
4. If the lateral grade of the existing street exceeds 2.5%, the grade will be set by the City's Project Manager.

24.00 GENERAL (Continued)

I. FOUNDATIONS AND BASES

Foundations and bases shall be constructed and/or installed in conformance with Lincoln Standard Plans (LSPs) LSP 82 and 92, to the elevation as shown on the plans or directed by the City's Project Manager.

All foundations shall be poured within 48 hours of excavation.

Positioning of anchor bolts shall ensure that all access and relative position of the structure and its components are in the position shown on the project plans. Anchor bolts shall be set so that 2 bolts are placed in tension and 2 in compression.

Foundations and Bases will not be measured for payment separately, but are considered subsidiary to the installation or relocation of poles or traffic signal cabinets.

1. Reinforced Concrete

Forms shall be firmly braced and secured in place. Forms shall not be removed until the concrete has set, and at no time shall they be removed within 12 hours after the concrete has been placed.

Prior to pole and cabinet installation, anchor bolts and foundation holes shall be barricaded or suitably enclosed to protect the public from possible injury.

All reinforcement bars for concrete reinforcement shall be epoxy coated, Grade 40 or Grade 60 steel and shall conform to the requirements of "Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement", ASTM Designation A615, or "Standard Specifications for Raw Steel and Axle-Steel Deformed Bars for Concrete Reinforcement", ASTM Designation A 996. Bars shall be free from excess rust, scale or other substances which prevent the bonding of concrete to the reinforcement.

There shall, in all cases, be at least 3" of concrete between anchor bolts and epoxy coated steel reinforcing members at any edge of foundation or base.

No foundation or base shall be poured until they are free of water or debris including trash. The bottom of the foundations and bases shall rest securely on firm undisturbed ground. Both forms and excavations shall be thoroughly wet before placing concrete. An Observer shall be present for the pouring of all traffic signal foundations and bases. The Project Manager shall be contacted 24 hours in advance of the pour. Any foundations poured without the Observer present shall be subject to removal and replacement at the Contractor's expense.

The foundations and bases shall be L3500 concrete, poured monolithically and consolidated with a mechanical vibrator as it is placed, from the bottom to the top, in the form. No floating of steel allowed. The top and any exposed portion of the foundation or base shall be troweled smooth, true and level.

Anchor bolts shall protrude within the range shown on LSP 82 with the nuts and threads covered to protect them during pouring.

Grinding concrete to form a chamfer shall not be permitted.

24.00 GENERAL (Continued)

I. FOUNDATIONS AND BASES (Continued)

1. Reinforced Concrete (Continued)

After the foundation or base has been poured, no modification shall be made. If the anchor bolts, conduit, or any part of the foundation or base are installed in an incorrect manner, as determined by the City's Project Manager, the entire foundation or base shall be removed and a new foundation or base installed. The Contractor shall bear all costs of replacing work, including cost of anchor bolts, deemed unsatisfactory by the City's Project Manager.

Pole shafts shall not be set on the foundations until the concrete has achieved a compressive strength of 2500 psi or an age of 72 hours. Mast arms shall not be installed until the concrete has achieved a compressive strength of 3000 psi or an age of 7 days.

2. Power Installed Foundation

The Power Installed Foundation shall be of the size required by the luminaire mounting height as shown on LSP 92.

The Power Installed Foundation is not to be used in fill areas or where the soil bearing strength is less than 1,500 pounds per square foot or on slopes in excess of 5%.

Power Installed Foundations shall be installed in conformance with the manufacturer's instructions. The foundation shall be installed with its axis plumb. Cable entrance shall be parallel to the street unless indicated otherwise in the plans or directed by the City's Project Manager. Trenches for conduit or cable shall be as narrow as practical, but in no case shall the trench width exceed the diameter of the foundation shaft.

J. DOWNTIME FOR TRAFFIC SIGNALS OR STREET LIGHTING

When the described Work includes any task that renders the existing traffic signal system inoperable, the downtime necessary shall be coordinated with and approved by the City of Lincoln Traffic Engineering Division and the City Project Manager.

There shall be No night time disruption to existing street lighting at any time during the project. Any street light disruption shall be restored to full operation prior to other project work commencing.

24.00 GENERAL (Continued)

K. ENERGIZING OR DE-ENERGIZING TRAFFIC SIGNALS

It is the intent of this Standard Specification to minimize interruption to both vehicular and pedestrian traffic and activities in the area adjacent to the described Work.

A Traffic Signal or Pedestrian Signal shall only be turned off by City personnel.

The Contractor is responsible for contacting LES, to have LES energize or de-energize any Street Light Cable or energize Service Cable for Traffic Signal Equipment. Under no circumstance shall the contractor open any LES locked facilities, such as a Transformer or Pedestal.

Prior to a new or rebuilt signal being turned on, in flashing or permanent operation, the Contractor shall have completed all non-LES splices; including signal display, detection, power, pre-emption, and flash testing of the completed installation.

The Work shall be planned such that the City Traffic Engineering personnel are notified 48 hours prior to placing the signal in flash. In cases where multiple signals are involved, 48 hours for the first signal and 24 hours per additional signal shall be provided. Signal turn-ons shall occur between 9:00 a.m. and 2:00 p.m., Monday through Thursday.

New signalized locations shall be placed in pre-determined flashing operation for a minimum of 7 days, with the exception of new streets.

L. ANTI-SEIZE COMPOUND

The Contractor shall use an approved anti-seize compound everywhere metal screws into, onto or against metal.

M. SUBSTANTIAL COMPLETION

The traffic signal and/or street lighting portion of projects shall not be considered substantially complete until all items shown on the design plans or called for in any contract document are completed to the satisfaction of Traffic Engineering, excluding seed/sod if outside planting season. This substantial completion shall include all street lighting and communications systems components and the submittal of completed AS BUILT plans. The Contractor is responsible for identifying any changes in the construction from the original plans so that updated information can be documented in AS BUILT plans. The system shall be fully operational in conformance with the project plans, City of Lincoln Standard Specifications, and any special provisions.

Liquidated damages shall continue to accrue until such time as the Work is deemed to be substantially completed by Traffic Engineering.

24.00 GENERAL (Continued)

N. INSPECTION COMPLETION

Prior to the start of inspection, 1 hard copy and 1 electronic copy of as-built plans shall be provided to the City. These as-built drawings shall be labeled "AS BUILT", with the Contractor's initials and date.

Upon completion of a fully operational traffic signal, ITS, lighting, and communications system, and submittal of AS BUILT plans, an inspection shall be completed by the City. The Contractor shall correct any items as listed on the inspection forms, return inspection forms back to City, and correct any subsequent deficiencies identified by inspections until City accepts all work. The number of allowable calendar days, including the inspection process, and any associated liquidated damages shall be defined in the project contract documents.

O. SIGNAL SUPPORT SPAN

Span wire shall be 3/8", galvanized, 7 strand, high-strength grade steel wire strand. Signal support span wire shall, in all cases, have a minimum strength capable of supporting the maximum load to which they may be subjected. Tie wire shall be 1/4" diameter high-strength grade steel wire strand. Tie wire installed for any one span wire mounted location shall be the same diameter for all tie wire spans. Span wire and tie wire shall conform to the requirements of "Standard Specifications for Zinc-Coated Steel Wire Strand", ASTM Designation A-475.

All ferrous metal line hardware items shall be galvanized and shall conform to the requirements of "Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware", ASTM Designation A153. All hardware items shall have a minimum strength capable of supporting the maximum load to which they may be subjected.

Pole clamps used for signal support spans and messenger cable shall be installed in such a manner to prevent any rubbing or strain of the cable clamp against the pole clamp or its connecting bolt. 4 piece (90° separation) clamps shall be used.

Span wire shall be installed with 5% sag, +/- 1%, with traffic signals installed, and shall be adjusted on the poles so as to provide the proper mounting height indicated on the plans.

Tie wires shall be pulled snug to stabilize the traffic signal heads, but shall not support any of their weight. A tie wire safety link as described on the plans furnished by the City and installed by the Contractor shall be placed between the pole band and tie wire. Under no circumstances shall the tie wire be utilized to plumb poles.

24.01 REMOVE OR RELOCATE OR ADJUST

A. GENERAL

Existing traffic signal and/or street light components or systems shall be removed, relocated or adjusted in conformance with the plans and these Standard Specifications. All bases and foundations shall be removed completely. All poles or components indicated to be removed shall become the property of the Contractor except as noted on the plans or by the Special Provisions. Equipment designated for return shall be returned to the location shown on the plans. Retained equipment and material shall be protected to prevent damage. The cost of damaged equipment or materials shall be deducted from the final payment. The excavation remaining after the removal of an item from below grade shall be backfilled in conformance with Chapter 20 of these Standard Specifications.

B. BASIS OF PAYMENT

1. Remove

REMOVE (Rem) _____, completely removed and accepted by Traffic Engineering, shall be measured for payment as single units, except cable as linear feet and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for removing and disposal of all materials; removal of existing foundation, existing luminaire, ground rod or existing base, for all excavation and backfill; for the return of equipment designated for return and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work in conformance with the plans and these Standard Specifications.

2. Relocate

RELOCATE (Rel) _____, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units, except cable as linear feet and shall be paid for at the contract unit price bid per each for the item. Relocate Poles and Cabinets includes removal of existing foundation or base, existing luminaire, excavation and backfill; new foundation or base and contractor supplied concrete, conduit stub-out, epoxy coated reinforcing steel, power installed foundations, pole setting foam, ground rods and anchor bolts. This price and payment shall be full compensation for all removal from original position and installation to proposed position, and for all labor, equipment, tools, materials, storage, and incidentals necessary to complete the Work in conformance with the plans and these Standard Specifications. Clamp Kit shall be provided by City if needed.

3. Adjust

ADJUST (Adj) _____, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all adjustments from the original position, orientation and installation to the proposed position, excavation and backfill; and for all labor, equipment, tools, materials, storage, and incidentals necessary to complete the Work in conformance with the plans and these Standard Specifications. Clamp Kit shall be provided by City if needed.

24.02 TEMPORARY TRAFFIC SIGNAL

A. GENERAL

Temporary traffic signal systems shall be installed as called for in the project contract documents. The City shall furnish the Contractor with traffic signal and pedestrian signal heads, traffic signal cabinet, luminaires, overhead signs, detectors and assemblies, complete with the correct hardware for the application, such as, hanger assembly and tether for span wire installation. All other materials shall be furnished and installed by the Contractor, unless otherwise noted.

The Contractor shall make arrangements with LES for power service for the temporary signals. Any delay resulting from a Contractor's untimely request to the Utility for temporary power service shall not be justification for the suspension or adjustment of the calendar days on a project. The Contractor shall be responsible for the utility costs to install or relocate the power service.

When the Temporary Traffic Signal is approved for removal by the City of Lincoln, the Contractor shall remove the traffic signal and return furnished materials to the City. The cost of the damaged material shall be deducted from the final payment.

B. BASIS OF PAYMENT

INSTALL AND REMOVE TEMPORARY _____, complete, in place, removed and accepted by Traffic Engineering, shall be measured as a single unit and shall be paid for at the contract unit price per each system. This price and payment shall be full compensation for furnishing all materials not furnished by the City, installing all materials, connecting, maintaining, and removing the temporary signal system, salvaging requested items from the temporary signal, and for all labor, equipment, tools, materials, excavation, and incidentals required to complete the Work.

24.03 CONDUIT

A. GENERAL

Conduit used for cable runs shall be rigid polyvinyl chloride (PVC) conforming to Underwriters Laboratories (UL) "Standard for Safety" UL-651, or in the case of HDPE, ribbed or smooth wall. Conduits for Fiber Optic Cable installation shall be orange and conduits for Electrical shall be black/gray.

1. Rigid Polyvinyl Chloride (PVC) Conduit, Schedule 40

Standard plastic couplings must be used to join conduit ends. The conduit may be formed or bent by warming until it is flexible and pliable enough to work easily. Wrinkles or buckling will not be permitted. Conduit must not be heated to the point of deterioration or damaging the material.

2. High Density Polyethylene (HDPE) Conduit, Schedule 40

All HDPE conduit shall have a tensile strength of 4000 psi. Either smooth wall or ribbed types are acceptable for traffic signal applications. All street light applications shall use smooth wall.

3. Main Line Conduit Group (MLCG), ASTM D 1248 Type III Class C, Grade P33, Category 5, SDR 11 unless otherwise specified in the Plans.

All Main Line Conduit Group shall consist of (6) 1-1/4" High-density polyethylene (HDPE) conduits in conformance with the requirements of NEMA TC7. Conduit shall be smooth wall coilable duct meeting the requirements of ASTM D 1248 Type III Class C, Grade P33, Category 5, SDR 11 (direct bury), SDR 13.5 (installed within other conduits), SDR 15 (if allowed on specific project plans), unless otherwise specified in the Plans.

B. INSTALLATION

Electric (Street Light Only) Conduit shall be placed at a depth of 2'-6". Traffic Signal Conduit shall be placed at a depth of 3'-6". Fiber Optic Conduit shall be placed at a depth of 4'-6".

The routing of conduit as shown in the plans indicates, the location and direction of the conduit runs. If, due to obstructions or certain other field conditions encountered during construction, it is necessary to depart from the routing shown, Traffic Engineering will determine the new location in the field.

Conduits shall be secured in their permanent positions during the pouring and curing of the foundation or base or placement of rock in pull boxes. The installation of transformer base-type poles requires that the conduits shall be placed as near the door opening as possible.

Conduits terminating in pull boxes shall be routed under the pull box and cut parallel to the pull box lid.

The individual conduits in the MLCG shall be bound together as one with a hose clamp at the bottom of the pull box line.

A continuous length of polypropylene, 200-pound pull string shall be placed in City designated fiber conduit with 10' extra neatly secured at each end.

A continuous Fiber Locate Cable shall be placed in City designated fiber conduit.

24.03 CONDUIT (Continued)

B. INSTALLATION (Continued)

The Contractor shall use 90° factory sweeps, with a 48" radius, in controller bases, the home run pull box (first electrical pull box to the cabinet) and in fiber pull boxes; in all other cases, the Contractor shall use 90° factory bends with a 16" minimum radius.

All joints and terminations shall be made in conformance with the manufacturer's instructions and good practice. Joints shall be watertight and mechanically sound. The conduit shall not contain debris or other foreign matter and shall have a constant circular cross-sectional area.

For communication system conduits, any fiber conduit entering the bottom of fiber pull boxes shall be located in the near right side corner of the box, as you approach, at least 4" from the side and end walls. The conduit shall be sloped towards the top far edge of the box to facilitate pulling of the cables. In applications where MLCG is utilized, the conduits shall be hose clamped together, 6" from the end of the conduits. The hose clamps shall be installed prior to rock backfill in the pull box. When long radius sweeps are needed to bring the MLCG into a pull box, a compression coupling capable of providing a watertight connection in buried or restrained applications shall be used. In the unusual event that the MLCG is shallow MLCG penetrations into the side wall of pull boxes shall be made using single conduit knockouts or cored entrances.

In special cases, only approved by Traffic Engineering, conduits entering through the side wall of pull box shall be located a minimum of 4" above and maximum 8" above the floor, 4" away from the pull box corner and shall extend 4" inside the box wall. The void between the knockout and the conduit shall be filled with mastic to form a watertight seal.

Excavation for trenches shall be backfilled and compacted daily unless properly protected. All excavations shall be backfilled within 48 hours of excavation. Any excavation required to be open longer than 48 hours will need approval by Traffic Engineering. The first 4" of backfill for trenches shall consist of finely pulverized earth and shall contain no broken glass, rocks, or other sharp material that might damage the conduit. The remainder of the backfill material will normally be earth excavated from the trench unless such earth is water saturated or frozen. Backfill material shall be substantially dry, loose, clean earth free from rocks and debris. Excessively dry or excessively sandy material is not permitted. Before backfilling, all standing water shall be removed from the trench. Tamping shall be done at no more than 12" backfill level intervals to ensure proper compaction throughout the depth of the void. Hand tamping is not permitted. All excess backfill material shall be removed promptly from the site.

C. CONDUIT BORED

When shown on the plans the jacking or directional boring of conduit is to be done with equipment designed and designated for that purpose or other approved methods where a constant pressure can be applied and controlled, and in conformance with approved procedures.

Pavement shall not be disturbed without the approval of the City's Project Manager. Jacking or directional boring shall be kept 24" from the edge of any type of pavement wherever possible. Excessive use of water which might undermine pavement or soften sub grade will not be permitted.

Determine all utility locations near the path of the proposed pushed (bore) conduit, including depth. Use this information to avoid damage to utilities and/or facilities within the work area. Provide this information, including the sources, to the City's Project Manager a minimum of five working days prior to boring. Do not bore until the City's Project Manager approves that submittal.

24.03 CONDUIT (Continued)

C. CONDUIT BORED (Continued)

Prior to boring, expose all utilities for which it is customary and safe to do so.

The diameter of the drilled hole shall conform to the outside diameter of the conduit as closely as practical. Pressure grout as directed by Traffic Engineering, to fill any voids, which develop during the installation operation. Remove and replace any conduit damaged in directional drilling operations at no expense to the project.

Conduit logs detailing bore depth shall be presented to the City after all boring operations. Conduit logs shall include as built drawings of conduit and GPS location measurements of all pull box lids accurate to 10 digits. All conduit logs shall be electronic and of a format approved by the City of Lincoln.

Repairs to conduit shall use a coupling capable of providing a watertight/airtight connection in buried or restrained applications.

The use of water and other fluids in connection with the drilling operation will be permitted only to the extent necessary to lubricate cuttings. Jetting will not be permitted, and the use of water alone as a drilling fluid will not be permitted. Use a drilling fluid/slurry consisting of at least 10% high grade, processed Bentonite to consolidate excavated material, seal the walls of the hole, and furnish lubrication for subsequent removal of material and immediate installation of the pipe.

Provide a means of collecting and containing drilling fluid/slurry that returns to the surface, such as slurry pit, or a method approved by Traffic Engineering. Provide measures to prevent drilling fluids from entering storm sewer systems. Prevent drilling fluid/slurry from accumulating on or flowing onto sidewalks, other pedestrian walkways, driveways, or streets. Immediately remove any slurry that is inadvertently deposited on pedestrian walkways. Transport waste drilling slurry from the site and dispose of it. Do not allow slurry to enter wetlands. Protect wetlands using appropriate soil erosion control measures approved by Traffic Engineering.

Boring fluid shall be appropriate for soil conditions. Waste oil and/or environmentally non-compatible polymers shall not be part of the drill fluid composition. Used boring fluid shall be properly, and legally, disposed of.

The contractor shall continuously monitor boring operations for possible frac-out of drill fluid. Any frac-out or surface uplifting shall be contained, cleaned up, and repaired.

Use a digital walkover locating system to track the drill head during the bore. At minimum, the locating system shall be capable of determining the pitch, roll, heading, depth, and horizontal position of the drill head at any point along the bore. During each drilling operation, locate the drill head every 10' along the bore and prior to crossing any underground utility or structure. Upon completion of the drilling operation and conduit installation, furnish the City's Project Manager with an as-built profile drawing and plan drawing for the drilled conduit showing the horizontal and vertical locations of the installed conduit.

D. CONDUIT IN TRENCH

Conduit in trench shall mean conduit which is directly buried in earth and shall be installed in suitable trenches in conformance with 24.00.F.

24.03 CONDUIT (Continued)

E. BASIS OF PAYMENT

CONDUIT, ____", BORED; CONDUIT, MAIN LINE GROUP BORED; CONDUIT, ____", TRENCHED; and CONDUIT, MAIN LINE GROUP TRENCHED, complete, in place and accepted by Traffic Engineering, shall be measured as lineal feet from and to centers of pull boxes, cabinets, and poles and shall be paid for at the contract unit price bid per linear feet for the conduit. This price and payment shall be full compensation for all excavation required; pulling string (in City fiber conduit), fiber locate cable (in City fiber conduit), conduit caps, hose clamps, backfilling and compacting; and for all labor, equipment, tools, materials, and incidentals required to complete the Work.

Pulling String and Fiber Locate Cable are subsidiary to City communication conduits. The installation of conduit stub outs as called for on the plans, including necessary couplings, elbows, sweeps and bends shall be considered part of those items for which payment is made and shall not be measured separately.

24.04 BLANK ON PURPOSE

24.05 PULL BOXES

A. GENERAL

Pull boxes, T6, T9, TR27, T48 and their lid are required to conform to all test provisions of ANSI/SCTE 77 "Specifications for Underground Enclosure Integrity" Tier 15 and labeled as such inside the pull box and on the top of the lid. All lids are required to have a minimum coefficient of friction of 0.5 in conformance with ASTM C1028. Independent third-party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this Standard Specification have been met are required with each submittal. Pull Box, T48 shall have a split lid (2-piece).

Pull box shapes and nominal dimensions shall conform to LSP 81.

Pull box lids shall also be labeled "ELECTRIC", "TRAFFIC", or "FIBER" on top as indicated on the Plans.

B. INSTALLATION

Pull boxes shall be installed at the locations shown on the plans.

The excavation for the pull box, T6 and T9 shall extend at least 12" below the bottom and 6" beyond the sides of the pull box. The pull box shall rest firmly on an aggregate base, meeting all of the requirements of coarse aggregate for concrete as described in Chapter 3 of the City of Lincoln Specifications.

Pull Boxes T6 and T9 shall have aggregate base that extends 12" below the bottom and at least 6" beyond the outside edges of the pull box. In addition, the aggregate base shall extend 6" up on the outer sides of the pull box, measured from the bottom of the box. The aggregate base shall be placed in 6" lifts and compacted with mechanical or hand methods to the satisfaction of Traffic Engineering. See LSP 81 for aggregate placement detail.

The remaining excavation shall be backfilled with soil and shall meet the requirements for backfill in Chapter 20 of the City of Lincoln Specifications.

24.05 PULL BOXES (Continued)

B. INSTALLATION (Continued)

The excavation for the pull box, TR27 and T48 shall extend at least 12" below the bottom and 12" beyond the sides of the pull box. The pull box shall rest firmly on an aggregate base, meeting all of the requirements of coarse aggregate for concrete as described in Chapter 3 of the City of Lincoln Specifications.

Pull Boxes TR27 and T48 shall have aggregate base that extends 12" below the bottom and at least 12" beyond the outside edges of the pull box. In addition, the aggregate base shall extend 12" up on the outer sides of the pull box, measured from the bottom of the box. The aggregate base shall be placed in 6" lifts and compacted with mechanical or hand methods to the satisfaction of Traffic Engineering. See LSP 81 for aggregate placement detail.

The remaining excavation shall be backfilled with soil and shall meet the requirements for backfill in Chapter 20 of the City of Lincoln Specifications.

Pull boxes shall not be placed in concrete unless specifically indicated on the plans or otherwise directed by Traffic Engineering.

Do not install pull box lid bolts.

Pull box edges, lid and lifting eye shall be kept clear of concrete and foreign material.

C. BASIS OF PAYMENT

PULL BOX, _____, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units for each type and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all excavation required; for furnishing and installing the pull box and lid; for conduit, conduit bends or long radius sweeps and aggregate base; and for all labor, equipment, tools, materials, and incidentals required to complete the work.

24.06 RISERS

A. GENERAL

A riser is a conduit vertically attached to a pole or a building used to hold cable. The riser shall be Galvanized Rigid Steel (GRS) conforming to the UL "Standard for Safety" UL-6 and PVC, Schedule 40, conforming to UL "Standard for Safety: UL-651.

B. INSTALLATION

All risers shall be the size specified in the plans, at the location shown on the plans. The riser shall be GRS a full 10' from grade up without joints, installed on standoffs and grounded. Risers mounted on the side of building shall be located as close to any existing underground network riser as is practical in a manner acceptable to Traffic Engineering. The steel portion of the conduit riser shall be grounded at the top.

All pole risers shall be on standoff brackets provided by LES. These can be picked up at the LES store room. See 24.00.E for location and hours. See LSP 83 for spacing detail.

LES is to build the Riser above the 10' of GRS and provide the cable to the meter when a meter is required. If there is no meter, then the contractor is to build the riser to its needed height and provide the cables, including enough cable for LES to energize.

The bottom 3' of service risers installed on buildings shall be encased in concrete not less than 3" in thickness. Concrete shall be L3500 conforming to the requirements of Chapter 3 of these Standard Specifications.

C. BASIS OF PAYMENT

RISER, _____", complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units for the various sizes and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all excavation required; for furnishing and installing the riser; for picking up and installing standoff, provided by LES installation, for conduit pipe clamps, ground wire, ground rod, concrete encasement, steel riser guards, meter socket, and incidentals are considered part of the riser assembly.

24.07 ELECTRICAL METER PEDESTAL

A. GENERAL

When placing an Electrical Meter Pedestal, the Contractor shall supply the pedestal. LES shall furnish and install KWH meter, cable from source to the meter and the upper part of the riser, when applicable. Metallic pedestals shall be bonded to the service neutral. A ground rod shall be installed at the pedestal and bonded to the service neutral. Meter socket shall be ring style. Meter socket is to have lugs to receive a 120/240 volts single phase 3 wire service.

B. INSTALLATION

Meter Pedestals shall be installed at the locations shown on the plans. See LSP 83 for installation detail.

C. BASIS OF PAYMENT

ELECTRICAL METER PEDESTAL, complete, in place and accepted by Traffic Engineering, shall be measured as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for the excavation and backfilling required, for furnishing and installing the pedestal, ground rod; for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

24.08 STEEL POLES

A. GENERAL

Street Light Pole Standard Specifications are found on LSP 92. Pedestal Pole Standard Specifications are found on LSP 90.

B. STREET LIGHT POLES

1. General

Poles shall conform in detail to the requirements set forth in this Standard Specification and as shown on the plans. Each pole shall consist of a steel shaft, grounding terminal, wire inlet, hand hole and handhole cover.

The following criteria shall be evaluated when designing these poles:

- a. Total weight of each luminaire - 40 pounds. Effective projected area for each luminaire shall be 1.4 square feet.
- b. Wind loads (gust factor of 104 MPH) shall be 23.5 pounds per square foot on all supported surfaces including projected area of luminaires, sign surface area of 8 square feet, and pole sections.
- c. Ice loads (unit weight of ice equal to 56 pounds per cubic foot) shall be assumed to be 1" of ice on the horizontal projection of all exposed surfaces including sign surface area of 8 square feet. A 1/2" radial ice coating shall be assumed on the vertical projection of all exposed surfaces.

2. Shaft

The shaft shall be of steel and shall be a continuously tapered tube fabricated from not less than No. 11 manufacturer's gauge thickness, best grade steel. The shaft shall have only 1 longitudinal welded joint and shall be free of intermediate horizontal joints or welds. Only 1 length of sheet steel shall be used which shall be formed into a continuously tapered shaft having a taper of approximately 0.14" per foot. The shaft shall then be cold rolled under enough pressure to flatten the weld and increase the physical characteristics of the shaft so that the metal will have a minimum guaranteed yield strength of 48,000 psi.

The cold rolling process shall form a round shaft with a top outside diameter of approximately 3". A 3" x 5" handhole with removable cover plate shall be centered approximately 18" above the ground line of the pole.

A grounding nut for accommodating a 1/2" 13 UNC threaded bolt shall be provided on the inside of the shaft so as to be easily accessible from the handhole opening.

The overall length of the shaft shall be such that the luminaire specified has its light center located per plan mounting height above the ground when mounted on the pole with the base of the pole to be a minimum of 4' below grade, when pole is embedded.

A wire opening with a minimum diameter of 1 1/2" shall be provided in the shaft. It shall be a grommeted, smooth surface opening to prevent damage to wire being drawn through the hole. The opening shall be approximately 24" below the ground line.

24.08 STEEL POLES (Continued)

B. STREET LIGHT POLES (Continued)

3. Pole Finish

After all welds have been completed on the pole shaft and arm, all parts shall be thoroughly cleaned of all loose scale and other foreign material and hot dip galvanized at the factory.

If painting is required as part of the project, after all welds have been completed on the pole shaft and arm, all parts shall be thoroughly cleaned of all loose scale and other foreign material and hot dip galvanized, then powder coated to specified paint color at the factory.

Care is to be taken during shipping and installation to protect the finish from any cuts or scrapes.

4. Modifications

The Contractor shall submit to the City's Project Manager for approval the name of the manufacturer and the type of pole he proposes to furnish. The Contractor or his representatives shall make no field modifications on any pole, or part thereof, without the written permission of the City's Project Manager.

Modifications shall be construed to mean any drilling, filing, tapping, cutting, bending, or any other operation that will change the physical, mechanical, or architectural qualities of the pole.

5. Festoon Outlet

Festoon outlet shall be wired with No 10 USE and fused at 2 amps at the base of the pole. Outlet covers shall be continuous use metal outlet covers.

24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS

1. GENERAL

This work includes furnishing and installing mast arm poles, combination mast arm/lighting poles, and all miscellaneous items as indicated in the Contract Documents.

Street Light Pole Standard Specifications are found on LSP 92. Pedestal Pole Standard Specifications are found on LSP 90.

2. DESIGN CRITERIA

Mast arm poles, combination mast arm / lighting poles, shall be galvanized steel or aluminum structures designed in accordance with the 2013 AASHTO Specifications for the Design and Construction of Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition. A Structural Engineer currently licensed to practice in the State of Nebraska shall seal all designs. The design wind velocity shall be ninety (90) miles per hour.

The following design factors shall be used in the design of mast arm pole and combination mast arm / lighting poles:

- Wind Speed: 90 mph wind speed. (AASHTO Section 3.8.2, Figure 3.8.3)
- Wind Recurrence Intervals: 50 year recurrence interval. (AASHTO Section 3.8.3)
- Unreinforced & Reinforced Holes and Cutouts: Design structure unreinforced and reinforced holes to conform to section 5.14.6 (AASHTO Section 5.14.6)
- Fatigue Category: Fatigue Category 2 (AASHTO Section 11.6)
- Galloping Loads: Structure shall not be designed to resist galloping-induced cyclic loads.
- Natural Wind Gust: Structure shall be designed to resist a natural wind gust load of 11.2 mph, based on the yearly mean wind velocity. (AASHTO Section 11.7.1.2)
- Truck Loads: Structure shall not be designed to resist truck-induced gust loads. (AASHTO Section 11.7.1.3)

Design structures to support the required signal heads, lighting systems, signal and lighting cables, signage, other required items, and ten (10) pounds of ice per linear foot per tube for the location and span indicated in the Contract Documents. Use the area of the signs shown or as noted on the Contract Documents for the design calculations.

Design all metal poles to support a twelve (12) foot luminaire arm and forty (40) pound luminaire. Once selected, use the same design patterns, materials, and basic member shape throughout the project unless otherwise indicated in the Contract Documents.

Design mast arms to support the required signal or luminaire load and required signal and lighting cables. The maximum design wind velocity shall be ninety (90) miles per hour after installation.

24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

3. METAL POLES

Metal poles shall consist of a round, tapered pole shaft of galvanized steel fabricated in accordance with the Contract Documents. Metal poles shall have one (1) longitudinal automatic electric weld. After forming, flatten the weld. Steel shall be in accordance with ASTM A595, Standard Specification for Steel Tubes, Low Carbon, Tapered for Structural Use. Incorporate a lifting U-hook at the top of the shaft. The U-hook shall support the weight of the entire pole.

The pole shall be continuous from the base to the height necessary for luminaire arm attachment as indicated in the Contract Documents.

The pole manufacturer shall state the amount of pole rake necessary for the pole to set plumb under the required loading after installation. The manufacturer shall certify that the metal pole(s) and hardware meet the strength requirements for the anticipated loading. Secure a one (1) piece galvanized steel anchor base of adequate strength, shape, and size to the lower end of the shaft using two (2) continuous electric arc welds. The base shall telescope the shaft of the pole. Locate one (1) weld outside the base at the joint between the base top and the pole shaft.

Furnish all hardware necessary to complete the metal pole assembly in accordance with the pole manufacturer's instructions. Hardware shall include, but not be limited to, bolts, nuts, washers, removable pole tops, anchor bolts, anchor bolt covers, and transformer bases. Galvanize all exposed metal hardware. Removable pole tops shall consist of a galvanized positioning cap screw and galvanized pole cap. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal arm mounting location. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

4. ANCHOR BOLTS

Anchor bolts shall be in accordance with ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength, and the Contract Documents. The manufacturer shall certify that the anchor bolts meet the strength requirements for the anticipated loading of the pole(s). The minimum yield strength shall be fifty-five thousand (55,000) psi. Thread the bolts a sufficient length to allow for proper installation.

Threads shall be full and sounds. Galvanize all exposed portions of the anchor bolt. Supply two (2) galvanized hexagon nuts and two (2) galvanized flat washers with each anchor bolt. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

5. MAST ARMS

Steel shall be in accordance with ASTM A595, Standard Specifications for Steel Tubes, Low Carbon, Tapered for Structural Use or ASTM 572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel. Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. Mast arms shall consist of galvanized steel shaft with a mounting device suitable for attaching the arm at the height specified in the Contract Documents. Mast arms less than fifty-five (55) feet shall be one (1) piece arms. Mast arms fifty-five (55) feet or longer may be one (1) or two (2) piece arms. The mast arm mounting shall be structurally sound and neat in appearance. The mast arm shall be field adjustable or provide a minimum of two (2) and the maximum of four (4) degree rise.

Supply a mast arm cap for the free end of the mast arm. Furnish one (1) rubber grommet of one (1) inch inside diameter for each signal mounting location. The manufacturer shall certify that the mast arm(s) meet the strength requirements for the anticipated loading.

6. LUMINAIRE ARMS

Luminaire arms shall consist of the galvanized steel shaft with a mounting device suitable for attaching the arm at the height specified. Steel shall meet the requirements for two (2) inch Grade A or Schedule 40 pipe in accordance with ASTM A53, Standard Specification for Pipe, Steel, Zinc (Hot-Dip Galvanized) Coated, Welded and Seamless. The mounting shall be structurally sound and neat in appearance. The mating arm and pole steel simplex attachments shall meet the requirements for Grade 65-35 steel castings in accordance with ASTM A27, Standard Specifications for Steel Castings, Carbon, for General Applications.

Channel scrolls shall be one and one-half (1 ½) inch by one-eighth (1/8) inch commercial grade steel the manufacturer shall certify the luminaire arm(s) meet the strength requirements for the anticipated loading.

Unless otherwise indicated in the Contract Documents, Lincoln Electric System (LES) shall supply the luminaire(s).

7. GROUT

Grout shall be non-shrinking and non-rusting and comply with the requirements for Grade A Pre-Hardening Volume-Adjusting Grout in accordance with ASTM C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout.

8. ANCHORS AND ANCHOR RODS

Anchors shall be three-way (3-way) expanding malleable iron anchors having a minimum diameter of eight (8) inches. Malleable iron shall be in accordance with ASTM A47, Standard Specification for Ferritic Malleable Iron Castings. Anchor rods shall be eight (8) feet long, five-eighth (5/8) inch diameter galvanized steel rods with thimble eye end.

Galvanizing shall be in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

9. FOUNDATION CONSTRUCTION

The Engineer will provide a Foundation Design to the selected Bidder. It is anticipated that the Foundation Design will be provided to the selected Bidder prior to NTP. Construct reinforced PCC foundations in accordance with Standard Plans, Standard Specifications, Design, and Contract Documents. Excavate, dig, and/or bore holes at the locations indicated in the Contract Documents or as directed by the Engineer. The excavation shall be dry and free of any loose materials before placing PCC. Forms shall be used for any portion of the foundation that will be exposed above ground. Level and secure all forms before commencing PCC placement. Install and secure all reinforcing steel, conduit, and anchor bolts before commencing PCC placement.

Concrete shall be specified by the Contractor's Foundation Engineer. Consolidate the PCC throughout the full depth of the foundation by inserting and withdrawing a vibrator multiple times during PCC placement.

Finish the top of the foundation to be approximately two (2) inches above the adjacent ground or structure unless otherwise indicated in the Contract Documents. Finish the top of the foundation to be flush with adjacent sidewalk.

Form removal and surface finishing and grout installation shall be in accordance with Lincoln Standard Plans and Specifications.

Backfill the excavation and restore any areas disturbed by the foundation construction.

a. POLE FOUNDATIONS

Metal pole foundations shall be round with a square cap. The minimum dimension for the mounting surface shall be two and one-half (2½) inches greater than the pole base or transformer base on all sides. Pole foundations shall be constructed in accordance with the Standard Plans.

Install and secure anchor bolts within the reinforcing steel before commencing PCC placement. Center the bolt circle in the middle of the foundation and set the anchor bolts plumb at a projection distance above the finished surface in accordance with the manufacturer's recommendations. Conduit bends shall be ninety (90) degrees and shall exit the foundation a minimum of thirty (30) inches below the surrounding surface. Plug the ends of the conduit before commencing PCC placement.

24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

10. GROUND ROD INSTALLATION

Supply and install a ground rod in accordance with the Standard Plans, the Contract Documents, and NEC Article 250. Install a No. 6 AWG stranded copper wire attached to the ground rod using an appropriate clamp and connected to the splice box on the pole shaft. Use No. 6 AWG green insulated stranded copper wire for conduit installations.

Grounding shall be in accordance with the NEC, local ordinances, all applicable codes, and the requirements of the local utility company supplying electrical power. Do not connect any grounding connections to a breakaway device. The maximum measurable resistance between the ground rod and a test stake driven two (2) feet into the ground adjacent to the pole foundation shall not exceed twenty-five (25) ohms. If the resistance exceeds twenty-five (25) ohms, install additional ground rods greater than six (6) feet apart and connected using a No. 4 AWG bare copper wire. The number of additional ground rods shall be as needed to produce a measurable resistance of less than twentyfive (25) ohms.

11. MAST ARM SIGNAL POLE INSTALLATION

Install mast arm signal poles and mast arms at locations indicated in the Contract Documents and in accordance with the Standard Plans. The Contractor shall provide the required anchor bolts and hold down lugs as part of the cost to install a mast arm pole. Hold down lugs shall be provided for both the top and bottom sides of the bottom plate of the base. If the constructed foundation and anchor bolts do not fit the mast arm pole, then the Contractor shall construct a new foundation with the correct anchor bolt size and bolt circle at no additional cost to the City.

Install mast arms in accordance with the manufacturer's recommendations and such that the loaded arm has a minimum clearance of seventeen (17) feet from bottom of all signals to the crown of the street. Rake the pole back more than the calculated deflection, load the pole, and plumb the pole by adjusting the leveling nuts.

24.08 STEEL POLES (Continued)

C. FOUNDATIONS, POLES, AND MAST ARMS, AND LUMINAIRE ARMS (Continued)

12. MEASUREMENT AND PAYMENT

The Engineer shall measure mast arm signal poles for payment by the type of each mast arm signal pole supplied, installed, and accepted.

The Engineer shall measure combination mast arm signal / lighting poles for payment by the type of each combination mast arm signal / lighting pole supplied, installed, and accepted.

The following items are considered subsidiary to items for which the Contract provides direct payment: licenses, or associated permits; tree or shrub trimming; loading, hauling, and installing all materials, mounting hardware, ground rod(s), and miscellaneous hardware; installing wire and/or conduit into an existing base/foundation/pad; installing guy wires and guy anchor assemblies; and restoration of the surrounding ground surface.

Mast arms and luminaire arms are subsidiary to mast arm signal poles and combination mast arm signal / lighting poles.

Payment shall be made under the following unless otherwise indicated in the Contract Documents. The Contract Price shall be full compensation for furnishing all labor, materials, equipment, tools, transportation, permits, licenses, and all incidentals necessary to complete the work.

Contractor shall submit shop drawings for approval for all Poles prior to purchasing or performing work.

<u>Description</u>	<u>Unit</u>
Mast Arm Pole	Each
Combination Mast Arm Pole	Each
Foundation Concrete	Cubic Yards
Foundation Steel	Pounds (lbs)
Foundation Design	Each

24.08 STEEL POLES (Continued)

D. INSTALLATION

Poles, pole arms and/or pedestals are to be installed at the locations shown on the plans, unless permission to change the locations is given by the Project Manager. Poles shall be placed so that modifications and/or attachments are carefully oriented, as indicated on the plans.

The Traffic Signal Pole handhole shall be opposite the mast arm.

The Street Light Pole festoon outlet shall be located on the side opposite the street and the hand hole shall be 90° right of the luminaire arm.

A ground rod shall be set in undisturbed earth as shown on LSP 82 and 92. A continuous bare copper ground wire shall be connected from the ground rod to the grounding lug on the pole. When transformer bases are used, the pole shaft section and the transformer base section shall also be bonded to the ground rod.

Pole shafts must be erected so that they are plumb with their entire load in place. The mast arms shall be correctly oriented, as shown on the plans. Plumbing of pole shafts shall be accomplished by adjusting the leveling nuts on the foundation anchor bolts. Shims or similar devices for plumbing or racking will not be permitted except for leveling of the transformer base as per the manufacturer. The Contractor is responsible for additional nuts and washers for the Pedestal Pole if needed.

The Contractor shall notify the City of any damaged poles or surfaces before they pick up poles from pole storage site. The Contractor shall handle all poles in a manner to prevent damage to pole surface. All poles shall be clean after erection, and damaged surfaces shall be repaired to Traffic Engineering's approval.

If traffic signal pole construction requires the pinning of the mast arm to the vertical shaft, once the mast arms orientation and height are verified by Traffic Engineering, the Contractor shall pin the mast arms as soon as possible.

24.08 STEEL POLES (Continued)

E. EMBEDDED STEEL POLE INSTALLATION

Embedded steel poles shall be backfilled with pole setting foam. The Contractor shall coat the entire vertical pole butt surface with foam from base 6" below ground line. The poles shall be masked to 1" above the ground line to prevent splattering and provide a uniform edge.

All holes for poles shall be drilled, augured or vacuumed. The soil shall be removed from the holes mechanically or vacuumed. The diameter of the finished hole shall not exceed the pole diameter at ground line more than 4" nor less than 2". Depths of holes shall be determined by embedment length requirements of the pole.

In case of over-drilling, the holes shall be backfilled to proper depth with compacted soil. The Contractor shall take every precaution to prevent surface drainage from entering the holes.

A 6" layer of crushed rock shall be placed in the base of each hole. The crushed rock shall have been sieved after crushing to remove excessive fines and shall be so graded to meet the following requirements:

Total retained on 1-1/2" sieve	0-5%
Total retained on 1/2" sieve	90-100%

A small section of PVC conduit shall be used during backfilling application to assure access to the underground wire inlet after the backfilling process has been completed to allow installation of the underground wire thru the pole setting foam.

Poles shall be plumbed and held in stationary position for no less than 20 minutes (or as recommended by the foam manufacturer) after the foam has been applied. The masking shall be removed as soon as the foam expansion reaction has ceased. The remainder of the hole shall be backfilled with clean earth and tamped.

Application and use of the foam shall be in strict adherence to the manufacturer's instructions. A copy of the manufacturer's instructions shall be present on the job site and available to the Project Manager. The age of the pole setting foam components shall not have exceeded the manufacturer's recommended shelf life under the conditions by which the manufacturer defines shelf life.

After the recommended curing period, the foam shall have a core density of not less than 4.2 pounds per cubic foot and shall have a sheer strength not less than 38 psi. and shall have a compressive strength not less than 75 psi.

The foam shall be tested, when required by Traffic Engineering, in conformance with ASTM D 2856/ANSI K 65.152; ASTM D 1623/ANSI K65.32; and ASTM D 1621/ANSI K65.31.

24.08 STEEL POLES (Continued)

F. BASIS OF PAYMENT

POLE, INSTALL _____ complete, in place, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for all excavation, for picking up and installing the pole, mast arm, luminaire arms, cable, conductors, span wire, tie wire, concrete, conduit stub-out, epoxy coated reinforcing steel, anchor bolts, concrete foundation, anchor bolt covers, power installed foundations, transformer base, breakaway base, pole setting foam, ground rods and clamps, and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

INSTALL MAST ARM, complete, in place, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the arm, all labor, equipment, tools, and incidentals necessary to complete the Work.

POLE, _____ complete, in place, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each. This price and payment shall be full compensation for all excavation, for furnishing and/or installing the pole, luminaire arms, cable, conductors, span wire, tie wire, concrete, conduit stub-out, epoxy coated reinforcing steel, anchor bolts, concrete foundation, anchor bolt covers, power installed foundations, transformer base, breakaway base, pole setting foam, ground rods and clamps, and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

24.09 GROUND RODS

A. GENERAL

Ground rods shall be high strength steel rods with chemically-bonded copper coverings to provide high-conductivity and to prevent electrolytic action. The copperweld ground rods shall be placed as shown on the plans, 2' from the pole base, and oriented on the same side as the hand hole or in a pull box, if called for on the plans or LSPs; they shall have a nominal diameter of 5/8" and 15' long, except to a Street Light Pole shall be 10' long. For worker safety 5' lengths of ground rod screwed together are allowed. Ground wires shall be connected to ground rods with one-piece non-ferrous clamps which employ set screws as tightening devices. Connections to ground rods shall not be taped.

All ground wires shall be No. 6 AWG, bare solid annealed copper wire unless otherwise specified on the plans.

B. INSTALLATION

Each pole, or pedestal or traffic signal cabinet shall be firmly connected to the ground rod provided for each using the grounding terminal or terminal lugs. Placing the ground wire under an anchor bolt nut, anchor bolt cover, or similar device will not be permitted. The Contractor shall attach ground wire to base using terminal lugs. To attach the ground to the pedestal pole base, drill a hole in the pedestal base to accept the terminal lug.

Each pole or pedestal shall be connected to the traffic signal cabinet and the ground rod using a circuit grounding conductor of the size required on the LSP.

Each steel pole shall be connected to both the pole ground and a separately installed circuit grounding conductor of the size called for on the plans.

Ground Rods shall be installed in Pull Boxes where specified on the plans. Ground rods shall be centered on the side opposite the curb and installed 3" away from pull box side walls. The top of the ground rod shall be 10" below the bottom of the pull box lid. Ground Rods in Fiber pull Boxes shall include a Fiber Locate Cable attached to the Ground Bar and attached to the 15' ground rod in the pull box.

C. BASIS OF PAYMENT

GROUND ROD, complete, in place and accepted by Traffic Engineering, shall be measured as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for furnishing and installing the Ground Rods; and for all labor, equipment, Fiber Locate Cable, tools, materials, and incidentals required to complete the work.

No measurement or direct payment will be made for ground rods, ground wire, attachments to existing ground, or grounding clamps installed in conjunction with wood or steel poles, pedestal poles, or the pull box nearest the traffic signal cabinet. Ground rods and ground wire shall be considered subsidiary to and included in the bid price for the items for which direct payment is made.

24.10 DETECTORS

A. GENERAL

Detectors shall be inductance loops, detector cameras, non-intrusive detectors, emergency detectors or pedestrian push buttons as called for on the plans. All loop locations shall be marked on the pavement by the Contractor prior to installation and approved by Traffic Engineering. All camera detector, non-intrusive detector, and emergency detector locations shall be located as indicated on the plans. The locations for these detectors shall be coordinated with Traffic Operations and approved by Traffic Engineering. The pedestrian push button locations shall be marked on the pole shaft by the Contractor prior to installation and approved by Traffic Engineering. The Contractor shall review the installation drawing prior to scheduling operations, so as to expedite the installation process and cause a minimum of traffic interference and to ensure correct placement of loops.

The Contractor shall adhere to the specified detector locations including the leads and conduit as shown on the plans. Loops shall always be centered in their respective lanes as identified by final pavement markings shown on the plans. Care should be taken to ensure loops are centered properly within through lanes and left-turn lanes should variable lane widths exist. If some unforeseen condition necessitates repositioning a loop, the change must be approved by Traffic Engineering.

B. LOOP DETECTORS

Loop Detectors are described as either Sawed Under Overlay or Preformed Under Street. Sawed Under Overlay are placed in base of existing streets in a 3/8" wide slot. Preformed Under Street Loops may be placed in or on the subgrade prior to placing the surface, or placed beneath surfacing material, as shown on the plans. All loops shall be 6' x 6'.

1. Sawed Under Overlay

After identification of the loop locations, the Contractor shall perform the actual layout by means of either a template or chalk line. All Work related to the installation of a particular loop, with the exception of the layout task, shall be complete in the same Work day.

a. Saw Cutting

Saw cutting will be allowed only when the temperature is 32° F and rising. The concrete cutting equipment shall make use of a tank supplied water source which has sufficient pressure to act as a blade coolant, lubricant, and slot cleaner. Diamond cutting blades utilized for the saw cut shall, without damaging the adjacent areas, provide a clean, well-defined slot having a 3/8" width. On milled surfaces to be overlaid, depth of the saw cut shall be 2" from the lowest groove. The perpendicular saw cuts shall not meet at the corners. Diagonal cuts shall be required at all corners and where the loop wire exits from the actual loop. The saw cut waste shall be collected in a manner to keep from storm drainage.

b. Cleaning the Saw Cut

After the cutting operation, the slots shall be free and clear of moisture and debris, and the presence of any jagged edges or other protrusions which might damage the loop wire.

24.10 DETECTORS (Continued)

B. LOOP DETECTORS (Continued)

c. Wire Installation

Loop detectors shall consist of three turns of wire. Loop wire shall go directly from the loop to a pull box. IMSA 51-5 No. 14 AWG wire shall be used. The loop wire shall be a continuous length, no splicing allowed. The wire brought to the pull box shall be clearly tagged, identifying the loop number using the labeling method as shown in 24.12.D. During installation, the loop wire shall be held in place by lengths of compressible polyethylene or polyurethane foam sealant backer rod, not to exceed 6". The backer rod shall be of sufficient number and size to hold the wire in place while the sealant cures and is resilient over the temperature range of -40° to +160° F. The top of the backer rod shall be at least ½" beneath the surface of the pavement. On milled surfaces, the backer rod shall be at least ½" from the lowest groove.

d. Sealing the Saw Cut

The sealant used to cover the wires in the slots shall be an elastic epoxy resin compound. The epoxy shall have a tack-free curing time of not more than 1 1/2 hours at 75° F. The sealant shall be applied into the slot to half depth.

When both the loop and lead-in slots are half filled, a check shall be made for air bubbles and material pile-up and then the slots shall be filled to street level. Excess sealant shall be removed by means of squeegee. There shall be neither a trough nor a mound formed. The sealant, when applied into the saw cut, shall displace all the air, and completely fill the area of the slot. Sufficient time for sealant curing shall be allowed before traffic is permitted to move over the area.

2. Preformed Under Street Loop Detector

The Contractor shall furnish and install preformed under street loop detector loop detectors at a depth of 0" to 6" under new pavement. Care should be taken to prevent damage to the loop and lead in before and during the paving operation.

The preformed under street loop detector loop may be formed to be rigid or flexible, with 3 turns specified. The wire shall be a continuous length, no splicing allowed. The end of the wire brought to the pull box shall be clearly tagged identifying the loop number using the labeling method as shown in 24.12.D.

3. Loop Acceptance

Each loop shall be tested at the cabinet prior to termination and acceptance. All tests shall have the following result prior to acceptance.

New Loop = infinity

New Loop and New Feeder Cable = infinity

C. PEDESTRIAN PUSH BUTTONS

The pedestrian push button assembly will be furnished to the Contractor by Traffic Engineering. Each pedestrian push button shall consist of push button assembly, instruction sign, frame, instruction sign screws and shims that shall only be used on the smaller poles to stabilize the Pedestrian Push Buttons. The shims shall not be used if they cause any separation from the pole to the Pedestrian Push Button.

24.10 DETECTORS (Continued)

C. PEDESTRIAN PUSH BUTTONS (Continued)

Pedestrian push buttons shall be mounted on the correct pole face as shown on the plans, 3'-6" above the adjacent walk surface, taking care to place so that the flat side of pole is flush with the Pedestrian Push Button. The Contractor shall supply brass mounting screws for mounting the assembly to the pole. The pole shaft wire entrance shall be a 7/8" diameter deburred hole. When 2 push buttons are on the same pole shaft, the common (white) cables are spliced in the hand hole or base, not jumpered together at the push buttons.

D. CAMERA DETECTOR

Camera Detector shall be installed on the mast arm at the location shown on the plans. The attachment to the arm shall be by use of the clamp kit, as specified in these Standard Specifications. The Contractor shall aim and adjust the camera under the supervision of Traffic Engineering. The pole mast arm wire entrance shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet.

E. NON-INTRUSIVE DETECTOR

Non-Intrusive Detector shall be installed at locations shown on the plans. The mounting bracket for the detector shall be furnished by Traffic Engineering. The Contractor shall aim and adjust the detector in coordination with Traffic Engineering personnel. The pole wire entrance shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet. Changes in mounting or adjustment to locations shall be approved by Traffic Engineering.

F. EMERGENCY DETECTOR

The Emergency Detector shall be installed on the mast arm at the location as shown on the plans. The attachment to the arm shall be by use of the clamp kit furnished by Traffic Engineering. The pole mast arm wire entrance shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet.

G. BASIS OF PAYMENT

DETECTOR, LOOP, PREFORMED UNDER STREET; DETECTOR, LOOP, SAWED UNDER OVERLAY; DETECTOR, INSTALL NON-INTRUSIVE; DETECTOR, INSTALL PEDESTRIAN PUSH BUTTON; DETECTOR, INSTALL CAMERA; and DETECTOR, INSTALL EMERGENCY, complete, in place, tested, and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item.

This price and payment shall be full compensation for the furnishing and installing the Preformed Under Street Loop Detector and for furnishing and installing Sawed Under Overlay Loop Detector, including epoxy, and sawing, and for installing furnished Pedestrian Push Buttons with Contractor supplied mounting screws, Camera Detectors, Non-Intrusive Detectors, and Emergency Detectors with Emergency Detector Clamp Kit, clamp kits not included, pull-box, conduit as specified, loop wire, and for all labor, equipment, tools, testing, materials, and incidentals required to complete the Work.

In the event a Preformed Under Street Loop Detector does not meet requirements or was not placed as per plan, the Contractor shall remove the street to the nearest joint, place a new Preformed Under Street Loop Detector as per plan and replace street, all at Contractors expense.

24.11 CABINETS

A. GENERAL

This section refers to pole and pad mount Cabinets.

Upon completion of the Work, each cabinet shall be properly placed, mounted, wired, and connected to operate as per Traffic Engineering.

Unless otherwise noted, the cabinet, auxiliary equipment, and mounting hardware will be furnished to the Contractor by the City, ready for installation by the Contractor.

B. INSTALLATION

The Contractor shall mount or place each cabinet, base, and concrete pad as shown on the plans in conformance with the LSPs. Pad mounted cabinets shall have a 4'-2" x 4' x 4" concrete pad in front of the main door. If stated on the plans the cabinet shall also have a 4'-2" x 4' x 4" concrete pad on the opposite side of the main door. The Cabinet pad/s shall be level in both directions.

The Contractor shall connect all conductors for signal heads, detectors, grounds, Fiber Locate Cables, service cables, and fiber optics into the traffic signal cabinet. The Contractor shall connect the service cables and have the power panel energized.

All cables shall be routed to the cabinet and neatly trained to their destination in the cabinet utilizing industry standard Velcro ties, and shall be clearly identified using the labeling method as shown in 24.12.D.

The Contractor shall work closely with Traffic Engineering in scheduling cabinet installations so as to minimize intersection down time.

Pole mounted cabinets shall be mounted on the designated pole with the top at 7' above the ground.

C. BASIS OF PAYMENT

CABINET, INSTALL, ____, installed, connected, cables labeled, tested and accepted by Traffic Engineering, shall be measured as a single unit and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the cabinet, concrete pad, base, all connections, epoxy coated reinforcing steel, concrete, ground rod and for all labor, equipment, tools, materials, excavation, and incidentals required to complete the Work.

24.12 CABLE

A. TYPES AND CLASSES OF CABLE

All classes of cable shall be on substantially constructed reels, plainly marked as to size, type, and insulation identification. Only 1 length of cable shall be shipped on each reel. All cable must be new. Damaged cable or repairs on damaged cable will not be permitted. All cables shall be stranded copper, unless otherwise noted.

1. Traffic Signal Cable

Traffic signal cable shall be IMSA Specification No. 19-1, No. 14 AWG.

2. Lead-In Cable

Lead-In Cable shall be IMSA Specification No. 50-2, No. 14 AWG.

3. Loop Detector Wire

Loop Detector wire shall be IMSA Specification No. 51-5, No. 14 AWG.

4. Service, Street Lighting, Circuit Grounding Cable and Pole Grounding Wire

The cable for underground circuits and pole grounding shall be single conductor, the size specified on the plans, type XLP USE-2, RHH/RHW-2 600 Volt, Copper Cable. UL 44 and UL 854, ICEA S-95-658/NEMA WC-70, C (UL) US Federal spec. A-A-59544. Pole ground wire shall be bare No. 6 AWG solid copper.

5. Emergency Detector Cable

Emergency Detector Cable shall be a shielded 3/c. The conductors shall be 20 AWG 7/25 BC 600Vac insulated. The colors shall be blue, orange, and yellow. The outside jacket shall be UV stabilized black polyethylene jacket, and have a total nominal outside diameter of 0.51".

6. Ethernet Communications Cable

Ethernet Communications Cable shall be Cat 6 or Cat 5E CMXT, Direct Burial, LSZH jacket, Shielded, w/Drain Wire, Waterproof Tape, 8-Conductor, Outdoor Jacket, 24AWG, Solid-Bare Copper and include connectors on each end of the cable.

7. RRFB Cable

RRFB Cable shall be IMSA Specification No. 19-1, 4 Conductor No. 18 AWG.

B. INSTALLATION

The installation of power cables shall, in general, conform to the NESC insofar as it applies, subject to the conditions and instruction of Traffic Engineering.

1. In Conduit

Prior to installation of underground cable, the Contractor shall insure that the conduit is open, continuous, free of water, and clear of debris.

24.12 CABLE (Continued)

B. INSTALLATION (Continued)

The cable shall be installed in such a manner and by such methods ensuring against harmful stretching of the conductor, injury to the insulation, or damage to the outer protective covering of the cable. An approved cable lubricant may be used to aid in pulling through conduit, when necessary.

Where more than 1 cable is to be installed in the conduit, all shall be pulled at the same time. 2' of extra cable shall be left on each lead extending beyond the hand hole in the base of all poles, above the top of all pull boxes, power pedestals, and each side of any splice. 6' of extra cable shall be left in the cabinet.

Under no circumstance will any cable be taped to another cable.

2. Pole Cable

The jacket of all pole shaft cables shall extend through the pole.

3. Direct Buried

Direct buried cable shall be installed in place with an approved cable plow at a depth of 30". In areas where trenching or plowing may damage utilities or the health of mature plants, the boring procedure shall be required.

C. SPLICES AND CONNECTIONS

No splices or joints will be permitted to be drawn inside the conduit, nor shall any splices or joints be made in any cable outside of pull boxes, pole bases or traffic signal heads.

Splices are not allowed in City furnished cable, Lead In Cable, Service Cable, Emergency Detector Cable, RRFB Cable and Ethernet Communications Cable. The only splice allowed in Traffic Signal Cable to heads or push buttons is at the pole hand hole. Street Lighting Cable and Circuit Grounding Cable shall be spliced only when a change in size or split of cables is shown on the plans.

Any cable end unused in a pull box shall be weather proofed with shrink tube or approved sealant, not tape.

All Traffic Signal splices and Street light splices below grade shall be made for continuous immersion in water.

Cable connections in signal heads or controller cabinets shall be made at the terminal boards provided for this purpose. All stranded wires inserted under a binder head screw shall be equipped with a solderless pressure-type spade connector with a pre-insulated shank. A crimping tool for insulated connectors shall be used. No bare wire or bare stud shall be exposed.

Service connections to the Cabinet shall be continuous from the power source.

All direct buried street lighting cable splices shall be inspected by LES before backfilling.

24.12 CABLE (Continued)

C. SPLICES AND CONNECTIONS (Continued)

1. Heat Shrink Splices

This splice shall be used to connect Traffic Signal Conductors in poles and Loop Detector splices in pull boxes. This splice shall be mechanically and electrically sound with bronze compression sleeve connection encapsulated in a permanent seal, waterproofing and insulating the electrical connection.

Wire ends must be thoroughly cleaned after the insulation is stripped off to ensure complete contact with another wire or the connector. If strands are damaged when the insulation is removed, the section of cable must be discarded. Nicked or damaged conductor strands will not be permitted inside of connectors. Loose wire ends shall not be used as “shims” to make a connection.

All connectors shall be designed for copper to copper connections. Only new connectors may be used. Connectors for compression sleeve splicing shall be of a type that when installed, the heat shrink products with proper mechanical and electrical properties may be utilized for all in-line splices of traffic signal control cable, loop feeder cable, traffic signal power supply cable, and other such applications.

The black heat shrink tubing shall be made of “thermally stabilized modified polyolefins” capable of minimum continuous use of 10,000 hours over an operating temperature range of -65° to +130° F.

The tubing shall be industry standard “thick wall type”, and shall have the ability to conform to severe configuration changes without splitting. It shall have a 3:1 shrink ratio.

The tubing shall be supplied with a factory applied sealant. When heat is applied, the sealant inside the product softens and flows around and over any irregularly-shaped configurations, filling voids and completely water sealing. The sealant shall remain in a semi-flexible state, assuring a complete moisture seal.

Heat sources for the shrinking process can be an electric heat gun or propane/butane gas torch capable of delivering at least 250° F. Scorched or burned splice components and/or sheathing will not be accepted.

2. Block Connectors

Street Light connectors to be used in poles shall be an approved 3- or 4-hole encapsulated connector.

3. Waterproof Block Connectors

This splice shall consist of a mechanically and electrically sound block connector encapsulated in a permanent gel capsule, waterproofing and insulating the electrical connection.

Splice connectors shall be an approved connector for use in a pull box. This connector shall be used only to connect tap wires to service cable, circuit ground and “in run” street light cables. Connectors shall be sized for the appropriate wire size and number of branch circuits.

24.12 CABLE (Continued)

C. SPLICES AND CONNECTIONS (Continued)

4. Direct Buried Splice

This splice shall consist of a mechanically and electrically sound compression sleeve encapsulated in an inline splice kit, waterproofing and insulating the electrical connection.

Splice the cable with a compression sleeve and wrap with an approved gel wrap for use in direct buried and secure with tie. This connector shall be used only to connect tap wires to service cable, circuit ground and “in run” street light cables.

5. Secondary Fuses and Fuse Holders

Secondary fuses for single luminaire circuits or in street light poles shall be an approved type KTK, 10 ampere. Secondary fuses for multiple luminaire circuits shall be an approved type KTK, 30 ampere. Fuse holders shall be an approved type HEB.

D. LABELING

Cables shall be identified by several wraps of colored tape at all access points. An approved colored tape shall be non-fading. Color code as follows:

Circuit Ground Cable:	Green
Traffic Service Cable:	
Neutral AC-	Yellow White
AC+	Yellow Blue
Street Light Cable:	
Neutral AC-	Red White
AC+ Phase 1	Red Blue
AC+ Phase 2	Red Blue Blue
AC+ Phase 3	Red Blue Blue Blue
Festoon Cable:	
Neutral AC-	Violet White
AC+ Phase 1	Violet Blue
AC+ Phase 2	Violet Blue Blue
AC+ Phase 3	Violet Blue Blue Blue
Metered Cable:	
Neutral AC-	Orange White
AC+ Phase 1	Orange Blue
AC+ Phase 2	Orange Blue Blue
AC+ Phase 3	Orange Blue Blue Blue

All other cables shall be identified with easy to read, good quality outdoor cable labeler.

Lead-In Cables shall be identified with phase and amplifier designation, both in the cabinet and the pull box where the loop detector is spliced. Traffic signal cables, push button cables, Ethernet Communication Cables, emergency detector cables shall be identified in the cabinet with the corresponding pole number using just the last digit (i.e. “POLE 1”). Communication cable and Fiber Locate Cable shall be identified in the cabinet with the direction of cable from the cabinet (i.e. “FIBER EAST”).

24.12 CABLE (Continued)

D. LABELING (Continued)

Since Fiber Locate Cable is so thin, labeling tape shall be placed on wire perpendicular to the wire like a flag.

E. BASIS OF PAYMENT

CABLE, _____ complete, in place and accepted by Traffic Engineering shall be measured as lineal feet from and to centers of pull boxes, cabinets, and poles, of such material of the size and type required and number of fibers or conductors. Cable shall be paid for at the contract unit price bid per linear feet.

This price and payment shall be full compensation for furnishing and installing cable, all necessary slack, testing, documentation, splices, connections, cable labeling, fuses and fuse holders, and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.

Cable inside loops, foundations, poles, pull boxes, cabinets, and other such devices or structures shall be subsidiary to those items and shall not be measured for payment.

CABLE, INSTALL complete, in place and accepted by Traffic Engineering shall be measured as lineal feet from and to centers of pull boxes, foundations, cabinets, and poles, of such size and type of material furnished by Traffic Engineering. Cable shall be paid for at the contract unit price bid per linear feet.

This price and payment shall be full compensation for installing cable, all necessary slack, testing, documentation, splices, connections, cable labeling, and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.

Cable inside loops, foundations, poles, pull boxes, cabinets, and other such devices or structures shall be subsidiary to those items and shall not be measured for payment.

24.13 SIGNAL HEADS AND OVERHEAD SIGNS

A. GENERAL

Signal heads and street name Overhead Signs are furnished to the Contractor by the City, ready for installation by the Contractor. The Contractor shall furnish the directional Overhead Sign for installation by the Contractor. The Contractor shall furnish mast arm clamp kit, shaft clamp kit, and down nipple extensions.

Overhead signs are furnished by the Contractor or furnished to the Contractor by the City, ready for installation by the Contractor. The Contractor shall furnish the mast arm clamp kit, shaft clamp kit, and down nipple extensions.

Traffic signal head adjustments shall be accomplished by adjusting the clamp kit and the connection from the signal head arm to the Head or Sign. The set screws in the aluminum pipe shall never be adjusted.

The clamp kit shall be high tensile aluminum alloy with a high strength galvanized aircraft cable and stainless-steel swaged fittings. The Contractor shall take care in selecting the length of cable required. If there is cable remaining, the Contractor shall tie wrap the excess in a tight coil.

The clamp kit shall have 2 sides with 1 1/2" IPS (iron pipe size) signal hardware on one side, and shall be adjustable on the other side to fit the traffic signal pole shaft or mast arm. The clamp kit shall attach to the pole shaft or mast arm by use of an adjustable stainless-steel cable and be able to rotate from horizontal to vertical in order to make the signal heads plumb or level. Installation shall be as per manufacturer's instructions.

B. INSTALLATION

Traffic Signal Heads, Pedestrian Signal Heads, Rectangular Rapid Flashing Beacons, Overhead Signs, and advanced flashers shall be installed as shown in the plans to the approval of Traffic Engineering. Each signal assembly shall be erected so that it is plumb, securely attached with all fittings tight, and present a neat appearance. Traffic signal heads shall be installed in line and all the same relative heights above the crown of the street. Pedestrian Signal Heads shall be aimed at the center of the appropriate ramp for which a person would wait for walk indication.

The pole shaft wire entrances for the Pedestrian Push Buttons and Pedestrian Signal Heads shall be a 7/8" diameter deburred hole with none of the hole exposed outside of the Pedestrian Signal Head. The pole shaft wire entrances for the Traffic Signal Heads shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet. The pole mast arm wire entrances for the Traffic Signal Heads shall be a 1" diameter deburred hole with a 1" inside diameter rubber grommet.

The pole shaft wire entrance for the cable to the arm shall be a 1 1/2" diameter deburred hole with a 1 1/2" inside diameter rubber grommet.

Down nipple extension 1 1/2" in diameter, and of appropriate length, shall be furnished and installed by the Contractor so that all signals on the span will hang at the same elevation as illustrated on the LSPs.

24.13 SIGNAL HEADS AND OVERHEAD SIGNS (Continued)

B. INSTALLATION (Continued)

If, after the signal assemblies are erected and the street is open to public travel, the signal is not put immediately into operation, the signal faces shall be covered securely with signal covers specifically designed for all signal heads. Burlap, cardboard, or plastic 'trash style' bags shall not be accepted. All signal covers shall be approved by Traffic Engineering prior to use. No inoperative signals on a street which is open to the public shall be left uncovered under any circumstances. Traffic Signal Heads shall stay covered until the signal is ready to be placed in flash operation. Pedestrian Signal Heads shall stay covered until the signal is ready to be placed in full operation.

C. BASIS OF PAYMENT

HEAD, INSTALL TRAFFIC SIGNAL, _____ SECTION, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the signal head and assembly (pipe and brackets), for furnishing and installing clamp kits, nipples, banding, pipe fittings, for all pole and mast arm modifications; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

SIGN, INSTALL OVERHEAD, complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up and installing the street name Overhead Sign and assembly (pipe and brackets) provided by City or installing the directional Overhead Sign provided by Contractor and assembly (pipe and brackets), clamp kits, nipples, banding, pipe fittings, for all pole and mast arm modifications; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

SIGN, INSTALL OVERHEAD; ADVANCED FLASHER ON MAST ARM, INSTALL; ADVANCED FLASHER ON SHAFT, INSTALL; INSTALL SPEED INDICATOR ON SHAFT and RECTANGULAR RAPID FLASHING BEACON, INSTALL complete, in place and accepted by Traffic Engineering, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item. This price and payment shall be full compensation for picking up or furnishing and installing the Overhead Sign, and assembly (pipe and brackets), picking up and installing Advanced Flasher on Mast Arm and assembly (pipe and brackets), picking up and installing Advanced Flasher on Shaft and assembly (pipe and brackets), picking up and installing Speed Indicator on Shaft, and assembly (pipe and brackets), for furnishing and installing clamp kits, nipples, banding, pipe fittings, for all pole and mast arm modifications; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

The furnishing, installing, maintaining and removal of any temporary covering for the signals during construction is considered subsidiary to the installation of the head. Such coverings remain the property of the Contractor after removal. All mounting hardware shall be considered subsidiary to the installation of the signal heads.

24.14 STREET LIGHTING AND LUMINAIRES

A. GENERAL

The luminaire and components shall have been designed for street lighting and shall conform to all the applicable requirements of the National Electrical Safety Code.

B. MATERIAL AND DESIGN

1. General

The street luminaires shall be similar in appearance to the 'cobra head' type luminaire. The following Standard Specification detail the mechanical, electrical, and optical properties required for each style of luminaire.

All parts, exterior and interior, when in contact with one another shall have a potential difference no greater than 0.25 volts in order to prevent corrosion due to electrochemical reaction.

Non-aluminum metal parts shall also be treated with corrosion resistant finish.

The external finish of the luminaire shall be gray and shall be of such quality that it will not, under normal environmental conditions, blister, crack, fade, or peel for the functional life of the luminaire.

The finish shall not have runs, streaks or foreign materials on the surface and have been evenly and thoroughly applied.

2. Luminaire Housing Assembly

The luminaire housing shell shall be constructed from pressure die cast aluminum. There shall be no rough or jagged edges protruding in either the interior or on the exterior body or edges of the shell.

The luminaire shall be provided with a field identification marker on the lower external surface of the unit. The marker shall conform to the NEMA Standards for Field Identification of High-Intensity Discharge Lamps in Luminaires, Publication No. OD 150-1977.

The luminaire shall consist of 2 sections readily separable from one another. In general, this shall be an upper body and a lower body. All sections shall be well matched to one another and when fully assembled, the luminaire shall be solidly and tightly composed.

The lower body shall be hinge mounted to the upper body and when in the open positions shall allow access to the electrical and/or the optical compartments. The hinge shall be capable of retaining the lower body to the upper body unsupported under full ice load (1" on all horizontal properties) and wind loads with maximum gust velocity of 110 miles per hour.

The upper and lower bodies shall be locked in the closed position with a vibration proof latch which is readily accessible, designed to prevent accidental opening, and may be opened without the aid of tools.

24.14 STREET LIGHTING AND LUMINAIRES (Continued)

B. MATERIAL AND DESIGN (Continued)

2. Luminaire Housing Assembly (Continued)

The luminaire shall include an EEL-NEMA Standard 7-pin, twist lock type photo electrical control receptacle. The receptacle shall be an integral part of the luminaire and shall be gasketed.

All electrical components and connections shall have been pre-wired at the factory so the luminaire is ready for immediate installation.

3. Photometric Requirements

The luminaire shall have a 'cut-off' type light distribution characteristic as follows:

- 1) Vertical distribution: IES - Medium
- 2) Lateral distribution: IES - M.C. III as required on the plans
- 3) Control of the candlepower distribution: Maximum candlepower shall fall between 66°-75° (degrees projected angles above nadir).

4. Electronic Photoelectric Controls

a. General

All controls must meet or exceed ANSI C136.10 - 1988.

b. Electrical Rating

- | | |
|-----------------------------------|---|
| 1) Line Voltage Operating Range | 105-305 VAC 60 HZ (240 Volt) |
| 2) Load Rating | 1000 Watt |
| | 1800 VA Ballast |
| 3) Contact Rated Life | 15,000 Operations Minimum |
| 4) Contact Chatter on Opening | Less than 5 milliseconds |
| 5) Dielectric Strength | 5000V Between Current Carrying Parts & Metal Mounted Surfaces |
| 6) Photocontrol Power Consumption | 1.5 Watts Maximum |

c. Time Delay & Failure Mode

- | | |
|-----------------|-------------|
| 1) On Delay | None |
| 2) Off Delay | 2-4 Seconds |
| 3) Failure Mode | Fail On |

d. Photosensor & Level Setting

- | | |
|-----------------------------|------------------------------------|
| 1) Type | Sealed Cadmium Sulphide or Silicon |
| 2) Turn On | 1.5 +/- 0.3 Footcandles |
| 3) Turn Off - Turn on Ratio | 1.5:1 |

e. Surge Protection

- | | |
|------------------|----------------------|
| 1) Type | Metal Oxide Varistor |
| 2) Joules Rating | 640 Minimum |

24.14 STREET LIGHTING AND LUMINAIRES (Continued)

B. MATERIAL AND DESIGN (Continued)

5. Electronic Photoelectric Controls (Continued)

f. Housing and Markings

- | | |
|---------------------------------|---|
| 1) Color | Black |
| 2) Cover Material | High Impact & UV Stabilized |
| 3) Base Material | High Impact |
| 4) Housing Skirt Size | 3" + 1/8" Diameter |
| 5) Base Markings and Provisions | Year & Month of Manufacture, Provisions |
| 6) Cover Markings | Manufacturer's Logo & Year of Manufacture |
| 7) Cover/Base/Receptacle Seal | Cross-Linked Polyethylene Gasket |
| 8) Plug Blades | Brass, 3 Blade NEMA Twist Lock |
| 9) Cover Window | Clear, UV Stabilized & Sealed |

g. Quality Control & Calibration

- | | |
|--------------------------------------|------|
| 1) Production Calibration - | 100% |
| 2) Inspection After Final Assembly - | 100% |

h. Other Type Tests

- | | |
|--------------------------------|---|
| 1) Ambient Temperature Range - | -40° C to +65° C |
| 2) Moisture Resistance - | 98% |
| 3) Drop Test | Drop of 3 ft. to Concrete Floor Without Damage to Housing or Electrical Operation |

i. Warranty

- | | |
|----------------|------------------|
| 1) Length | 12 Years Minimum |
| 2) Replacement | One for One |

Contact Lincoln Electric System for current list of approved vendors.

j. Circuit Board

Silicone Coated

C. LED STREET LUMINAIRE SPECIFICATIONS

References for this section include ANSI/NFPA 70, National Electrical Code (NEC) or latest issue, IEEE C63.41, Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits, FCC 47 CFR Part 15, Federal Code of Regulation (CFR) testing standard for electronic equipment, IESNA LM-79, Electrical and Photometric Measurements of Solid State Lighting Products, IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources, IESNA TM-15, Luminaire Classification System for Outdoor Luminaires, UL1598, Standard for Safety of Luminaires and IEEE C2-2012, National Electric Safety Code or latest issue.

Luminaires shall be of uniform quality and appearance. Manufacturers of LED luminaires shall provide a report or certification from a testing laboratory detailing a suitable testing program incorporating high heat, water, and thermal shock test regimens to ensure system reliability and to substantiate lifetime claims. The use of IESNA LM-80 data to predict luminaire lifetime is not accepted. At time of manufacture, each luminaire shall be tested for functionality and shall utilize a unique serial numbering scheme.

24.14 STREET LIGHTING AND LUMINAIRES (Continued)

C. LED STREET LUMINAIRE SPECIFICATIONS (Continued)

Each luminaire shall utilize a unique serial numbering scheme. Luminaires shall be provided with a minimum of 10-year warranty against manufacturing defects covering LEDs, dimmable drivers, surge protectors, photo control receptacles, and mechanical components. Warranty period shall begin at date of delivery.

If a manufacturer other than the approved vendors is to be considered, they must conform to LES Specifications. Submittals shall include luminaire cut sheets, cut sheets for LED light sources; cut sheets for LED dimmable driver(s); diagrams illustrating light output and input power as a function of control for dimmable LED driver; cut sheets for surge protection device; instructions for installation and maintenance; summary of luminaire recyclability per the FTC Green Guides, expressed by percentage of luminaire weight; description of luminaire, LED light sources(s) and LED dimmable driver(s) and manufacturer shall supply part number for light bars, drivers, and surge protectors of the luminaires supplied. Calculations and supporting test data indicating a lumen maintenance life of not less than 100,000 operating hours. Lumen depreciation curved for each driver. A completed Appendix B for each Appendix A. If proposed luminaires are on the LES Standards Approved List, only the catalog cut of the luminaire with catalog number must be submitted.

Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of housing, LED array, 7-pin photo receptacle, terminal block, surge protector, and electronic dimmable driver (power supply).

Each luminaire shall be rated for a minimum operational life of 100,000 hours at an average operating time of 11.5 hours per night. This life rating must be conducted at 25° C ambient temperature. The rated operating temperature range shall be -30° C to +40° C. Each luminaire must be capable of operating above 100° F (37° C), but not expected to comply with photometric requirements at elevated temperatures.

Photometry must be compliant with IESNA LM-79 and shall be conducted at 25° C ambient temperature.

The LED array should be constructed such that each individual LED has a dedicated lens assembly. Chip on Board (i.e. multiple LED's clustered under a single lens assembly) shall not be permitted, except for high mast applications. A catastrophic failure of one LED shall not result in the loss of the entire luminaire or more than a 10% total reduction in illuminance.

Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires.

Luminaires must have an external label per ANSI C136.15 and an internal label per ANSI C136.22.

Electrically test fully assembled luminaires before shipment from factory.

Luminaires shall be designed for ease of component replacement and end-of-life disassembly. Manufacturer shall submit information regarding recycling and proper disposal of luminaire and all individual components as well as name and address of nearest recycling location for materials.

Painted or finished luminaire components exposed to the environment shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117 and the coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

24.14 STREET LIGHTING AND LUMINAIRES (Continued)

C. LED STREET LUMINAIRE SPECIFICATIONS (Continued)

Mechanical design of protruding external surfaces (heat sink fins) shall facilitate hose-down cleaning and discourage debris accumulation.

Minimum color rendering index (CRI): 70. Correlated Color Temperature (CCT) shall conform to table below.

Manufacturer-Rated Nominal CCT (K)	Allowable LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv
4000	3710 to 4260	-0.005 to 0.007

All internal components shall be assembled and pre-wired using modular electrical components.

Luminaire shall have three-hole terminal blocks for incoming #10 AWG AC lines and a 7-pin photo control receptacle.

Access to internal components shall be latched and hinged in a manner to prevent accidental opening. Luminaire shall have ingress protection.

Maximum power consumption allowed for the luminaire shall be determined by application. The luminaire shall not consume power in the off state.

The luminaire shall operate from a 60 HZ AC line over a voltage ranging from 108 VAC to 305VAC. The fluctuations of line voltage shall have no visible effect on the luminous output. The luminaire shall have a power factor of 0.90 or greater. Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent. The luminaire circuitry shall include fused surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD shall protect the luminaire from damage and failure for common mode transient peak voltages up to 10kv (minimum) and transient peak currents up to 5ka (minimum). SPD shall conform to UL 1449. SPD performance shall be tested per the procedures in ANSI/IEEE C62.41-1992 (or current edition) for category C (standard). The SPD shall fail in such a way that the luminaire will no longer operate. The SPD shall be field replaceable.

Each luminaire shall have integral UL listed Class I power supplies.

The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

Dimmable LED drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

Dimmable drivers shall have a Class A sound rating.

LEDs shall be provided with optical elements to provide IESNA Type II, III, IV or V distributions. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type. For Type II and Type III distributions, street side efficiencies shall be a minimum of 70%. All LEDs and optical assemblies shall be mounted parallel to the street surface. All LEDs shall provide the same optical pattern such that catastrophic failures of individual LEDs will not constitute a loss in the distribution pattern.

24.14 STREET LIGHTING AND LUMINAIRES (Continued)

C. LED STREET LUMINAIRE SPECIFICATIONS (Continued)

The luminaire shall have a minimum B.U.G. rating of 3-0-4 or better.

The luminaire shall not allow more than 10% of the rated lumens to project above 80° nor 2.5% above 90° from vertical.

Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature. The heat sink shall be aluminum.

Luminaires shall be capable of withstanding cyclical loading in (G = Acceleration of Gravity) a minimum level of 3.0 G peak sinusoidal loading with the internal driver installed, for a minimum of 100,000 cycles without failure of any luminaire parts. Testing is to be performed in three planes: a horizontal plane parallel to the direction of mounting, a horizontal plane perpendicular to the direction of mounting, and the vertical plane.

The housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can run off the luminaire freely, and carry dust and other accumulated debris away from the unit.

The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 (minimum) to protect all optical components.

The electronics/power supply enclosure shall meet the requirements for NEMA/UL wet locations.

Housing shall be fabricated from materials that are designed to withstand a 3,000-hour salt spray test as specified in ASTM Designation B117.

Each refractor or lens shall be made from UV inhibited high impact plastic such as acrylic and be resistant to scratching.

Polymeric material of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VI flame retardant materials. The lens of the luminaire is excluded from this requirement.

All electronics and materials shall be lead free.

Luminaire shall have tool less entry.

Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email and supply onsite support when requested.

Manufacturers must be a street luminaire manufacturer and have a minimum of 5 years documented experience in LED street luminaire manufacture. References shall be provided upon request of at least 3 municipalities that currently have manufacturer's fixtures installed and operating.

D. INSTALLATION

Unless otherwise indicated in the plans or directed by the City's Project Manager, luminaires shall be installed level in both horizontal axes.

24.14 STREET LIGHTING AND LUMINAIRES (Continued)

D. INSTALLATION (Continued)

Each completed street light circuit shall have a 72 hour burn test prior to acceptance.

E. BASIS OF PAYMENT

LUMINAIRE, ____, complete, in place and accepted by the City's Project Manager, shall be measured as single units and shall be paid for as at the contract unit price bid per each for the item. This price and payment shall be full compensation for furnishing and installing the Luminaires and for furnishing bulbs, labor, equipment, tools, materials, and incidentals necessary to complete the Work.

24.15 CONCRETE POLES

A. GENERAL

Concrete Pole Standard Specifications are found on LSP 94.

B. INSTALLATION

Concrete Poles are to be installed at the locations shown on the plans, unless otherwise approved by Traffic Engineering. Poles shall be placed such that modifications and/or attachments are carefully oriented, as indicated on the plans.

The Concrete Pole hand hole shall be located on the side opposite the street.

Concrete Pole must be erected so that they are plumb with their entire load in place.

Poles shall be set to a depth and backfilled as per LSP 94. No frozen earth shall be used in tamping holes.

The excavation for Concrete Pole shall be 36" in diameter and extend 6" below the butt of the pole. The Concrete Pole shall rest level and firmly on an aggregate base and be backfilled 42" from bottom of excavation with aggregate material. Aggregate material shall satisfy all of the requirements of coarse aggregate as described in Chapter 3 of the City of Lincoln Specifications.

The remaining excavation shall be backfilled with soil that satisfies City of Lincoln Specifications for backfill material and shall be tamped every 4".

The Contractor shall notify Traffic Engineering of any damaged poles or surfaces before they pick up poles from pole storage site. The Concrete Pole shall be lifted and supported during transportation and erection operations as per Concrete Pole manufacturer recommendations. Ensure that transportation, site handling, and erection are performed with acceptable equipment and methods, and by qualified personnel. All poles shall be clean after erection.

C. BASIS OF PAYMENT

POLE, INSTALL CONCRETE, DIRECT BURY complete, in place and accepted by the City's Project Manager, shall be measured as a single unit and shall be paid for at the contract unit price per each for the item. This price shall be full compensation for the excavation required; pole installation; backfilling and backfill material; conduit long radius sweeps; for ground rod and ground wire connections; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

24.16 BLANK ON PURPOSE

24.17 BLANK ON PURPOSE

24.18 WOOD POLES

A. GENERAL

Wood poles shall be dense Southern Yellow Pine, and shall meet all ASA requirements for the length and class shown on the plans. Preparation of the timber for treatment, the method and result, shall conform to the requirements of "Standard Specifications for Pressure Treatment of Timber Products", ASTM Designation D-1760. The finished poles shall be sufficiently dry on the surface so that no preservative will bleed out and drip off the poles.

Poles shall be approved by an independent commercial laboratory.

B. INSTALLATION

Poles shall be set to a depth of 10% of the pole length plus 24". When earth fill is specified, earth around the hole shall be tamped solid, and to the satisfaction of Traffic Engineering. No frozen earth shall be used in tamping holes. Holes shall be of sufficient size to permit tamping completely around the pole.

Fill, other than earth fill, shall be as specified in the Special Provisions.

Guy wires shall be of the same diameter and tensile strength as the messenger cable supporting attachment to which they are linked, and shall conform to the requirements of "Standard Specifications for Zinc-Coated Steel Wire Strand", ASTM Designation A-475.

Ground anchors shall be power screw-type, having an 8" minimum diameter and using a 7' x 5/8" diameter rod to minimize soil disturbance, unless otherwise shown on the plans.

All ferrous metal line hardware items shall be galvanized and shall conform to the requirements of "Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware", ASTM Designation A153.

Guy guard shall be high visibility plastic 8' in length.

Down guys shall not enter the ground less than 24" from the edge of the sidewalk unless otherwise shown on the plans.

C. BASIS OF PAYMENT

WOOD POLE, ____ complete, in place and accepted by Traffic Engineering, shall be measured as a single unit and shall be paid for at the contract unit price per each for the item. This price shall be full compensation for the excavation required; for furnishing and/or installing the wood pole; for concrete as required, pole hardware, cable, conductors, span wire, tie wire, down guy, overhead guy; for ground rod and ground wire connections; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 25

ORNAMENTAL STREET LIGHTING

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CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 25

ORNAMENTAL STREET LIGHTING

ARTICLE	TITLE	
25.16	INSTALLATION OF LUMINAIRES	2506
25.17	INSTALLATION OF CABLE AND CONDUIT	2506
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CHAPTER 25

ORNAMENTAL STREET LIGHTING

25.00 GENERAL

The Work covered in this chapter shall include the furnishing of certain materials and equipment and the installation of all necessary materials and equipment to provide an ornamental street lighting installation complete, in place, and ready for operation in conformance with the plans and these Standard Specifications. No Work shall be done on any electrical circuits without making sure the connection to the source of supply has been broken. Arrangements for clearance shall be made with System Operations of the Lincoln Electric System (LES).

The City will furnish the material and/or equipment listed in the Special Provisions. All other material, equipment, and labor required to provide an ornamental street lighting installation in conformance with the plans and these Standard Specifications shall be furnished by the Contractor. Refer to the General Provisions and Requirements of the City of Lincoln Standards for procedures to be followed in handling City furnished materials and/or equipment.

All materials and equipment furnished by the Contractor shall be new and shall conform to the applicable standards of the National Electrical Manufacturers Association (NEMA), the Insulated Cable Engineers Association (ICEA), the International Municipal Signal Association (IMSA), the American Society for Testing Materials (ASTM), and the American National Standards Institute (ANSI). Installation of equipment shall conform to the requirements of the National Electrical Safety Code, and the ordinances of the City of Lincoln. Wherever reference is made in these Standard Specifications to the codes or standards mentioned above, the reference shall be construed to mean the code or standard currently in effect.

Material shall be as specified on the plans and in these Standard Specifications. Wherever manufacturer's catalogue numbers are used, that specific item is to be used unless approved equal material or another manufacturer's material is specifically authorized by the City's Project Manager.

Before ordering any material, the Contractor shall submit to the City's Project Manager for approval 2 copies of the manufacturer's Specifications and drawings for all of the equipment and materials indicated below. Materials shall be on the Lincoln Electric System's Standard Material List. The City shall not be liable for any equipment or materials ordered or purchased by the Contractor prior to approval.

- Paint
- Poles
- Luminaires
- Cables, Splicing and Termination Devices
- Conduits
- Fuseholders and Fuses
- Control Equipment, Breakers, Switches, Contractors, Relays
- Lightning Arrestors, Enclosures, etc.
- Brackets, Hardware, etc.
- Pull Boxes
- Wiring and Connection Diagrams of All Cabinets, Circuits
- Connectors

The manufacturer's Specifications and drawings shall include the brand name, any identifying numbers, required technical data, and any other information necessary for the City's Project Manager's review and for procuring exact replacements of any and all equipment and material used on this project.

25.01 ELECTRICAL CONDUIT

Electrical conduit shall be of the size and type shown on the plans. Quality and installation of electrical conduit shall be in conformance with Chapter 24 of these Standard Specifications.

25.02 ELECTRICAL CONNECTORS

See Chapter 24 of these Standard Specifications.

25.03 SECONDARY FUSES AND FUSE HOLDERS

See Chapter 24 of these Standard Specifications.

25.04 GROUND RODS

Ground rods shall be of high strength steel rod with a chemically bonded copper covering to provide high conductivity and prevent electrolytic action. Ground rods shall be at least 5/8" in diameter and 10' in length. Ground rods shall comply with the IMSA Specification No. 62-1956. Ground wires shall be connected to ground rods with one-piece nonferrous clamps which employ set screws as tightening devices. Connections to ground rods need not be taped.

25.05 POLES

A. EMBEDDED STEEL POLES

See Chapter 24 of these Standard Specifications.

B. FIBERGLASS POLES

1. General

The pole shall be hollow and nonporous, constructed of nonconductive fibrous glass and polyester resin. The pole shall be inert to soil chemicals, smog by-products, insecticides, herbicides, animal urine, mild acids and alkalis, deicing salts and saltwater. The surface finish shall be smooth.

The pole shall not be affected by ultraviolet radiation or weathering to the extent that no visible checking, chalking, deterioration or change of strength will occur during the normal life of the pole. The pole shall also be free from degradation by freeze-thaw cycles. The pole shall not support combustion.

2. Dimensions

a. Overall Length	23' Nominal
b. Burial Depth	4' Minimum
c. Mounting Height	Per plan to light center of luminaire
d. Handhole and Cover	2.5" diameter round, 18" above grade
e. Alternate Handhole and Cover	2.5" to 3" by 5" oval
f. Tenon Top	3" outside diameter by 3.5" long steel or molded

25.05 POLES (Continued)

B. FIBERGLASS POLES (Continued)

2. Dimensions (Continued)

- | | |
|-----------------------|--|
| g. Wire Entrance Hole | 1" to 1.5" minimum grommets, 24" below grade |
| h. Pole Butt | Approximately 7" diameter, square or non-symmetrical |
| i. Taper | 0.120" to 0.150" per foot of length |

3. Weight: Not greater than 65 pounds

4. Color: Black or grey, as specified on the plans

25.06 LUMINAIRES

All luminaires shall have an LED light source and shall be supplied as directed on the plans.

25.07 BLANK ON PURPOSE

25.08 ELECTRICAL CABLE

See Chapter 24 of these Standard Specifications

25.09 PHOTOELECTRIC CONTROLS

See Chapter 24 of these Standard Specifications

25.10 FERROUS HARDWARE

All ferrous metal used in line hardware items shall be hot dip galvanized in conformity with "Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware", ASTM Designation A153-53. The grade of steel and part design shall conform to Edison Electric Institute (EEI) Specifications where applicable. All hardware items shall have a minimum strength capable of supporting the maximum load to which they may be subjected.

25.11 PULL BOXES

All Work shall conform to Chapter 24 of these Standard Specifications.

25.12 GRADES

All Work shall conform to Chapter 24 of these Standard Specifications.

25.13 TRENCHING AND BACKFILLING

All cables, trenched or plowed, shall be 24" in depth on rear lot lines and 30" in depth on front and side lot lines. Cable route along the curb shall be centered approximately 5.5' from the sidewalk side of the curb unless otherwise specified on the plans.

All trenches shall be backfilled and compacted daily unless properly protected. All trenches for burial of electrical cable and conduit shall not exceed 6" in width.

The first 4" of backfill shall consist of finely pulverized earth and shall contain no broken glass, rocks, or other sharp material that might damage the cable. Where the cable enters conduit, care shall be taken to protect the cable as outlined elsewhere in these Standard Specifications.

The remainder of the backfill material will normally be earth excavated from the trench unless such earth is water saturated or frozen. Backfill material shall be substantially dry, loose, clean earth free from rocks and debris. Excessively dry or excessively sandy material is not permitted.

Before backfilling, all standing water shall be removed from the trench. Tamping shall be done at no more than 12" backfill level intervals to ensure proper compaction throughout the depth of the void. The foot of the compressed air or hydraulic tamper to be used to compact the backfill shall be sized in conformance with the width of the trench. Hand tamping is not permitted. All excess backfill material shall be removed promptly from the site.

Directional boring may be used by the Contractor with the City's Project Manager's approval.

25.14 RESTORING STREET SURFACES AND CONCRETE WORK

Improvements such as sidewalks, curbs, gutters, Portland cement concrete and asphaltic concrete pavement, bituminous surfacing, base material, and any other improvements removed, broken, or damaged by the Contractor shall be replaced or reconstructed in conformance with the applicable chapters of these Standard Specifications.

25.15 INSTALLATION OF POLES

A. EMBEDDED STEEL POLES

See 24.08.D of these Standard Specifications.

B. FIBERGLASS POLES

Fiberglass poles shall be installed in the same manner as set forth in 24.08.D, except that grounding shall be as specified in this Article and the use of polyurethane foam is optional.

An alternative to polyurethane foam backfill for fiberglass poles is earth backfill. Where earth backfill is used the diameter of the hole shall be sized in conformance with the diameter of the foot of the compressed air or hydraulic tamper to be used to compact the backfill. Hand tamping is not permitted. The distance between any point on the ground line of the pole to the perimeter of the hole shall be a minimum of 2" plus the diameter of the tamper foot, but not greater than the tamper foot diameter plus 6".

Backfill material will normally be earth excavated from the hole unless such earth is water saturated or frozen. Backfill material shall be substantially dry, loose, clean earth free from rocks and debris. Excessively dry or excessively sandy material is not permitted.

25.15 INSTALLATION OF POLES (Continued)

B. FIBERGLASS POLES (Continued)

Before backfilling, all standing water shall be removed from the hole. Crushed rock in conformance with 24.08.D shall be installed in the bottom of the hole. After the pole is plumbed and held fast in a true position, approved backfill material shall be installed in the voids between the pole and the hole perimeter. Tamping shall be done at not more than 12" backfill level intervals to ensure proper compaction throughout the depth of the void. After backfilling and tamping are completed, additional earth shall be banked around the ground line perimeter of the pole to a height of 3". All excess backfill material shall be removed promptly from the site.

A ground rod shall be installed a minimum of 24" from the nearest edge of the augered hole and a minimum of 12" below final grade. A continuous ground wire shall connect the ground rod to the grounding lead in the luminaire by means of the wire opening of the pole shaft.

25.16 INSTALLATION OF LUMINAIRES

All luminaires shall be leveled by means of bubble level after installation and the refractor shall be properly oriented with respect to the street.

25.17 INSTALLATION OF CABLE AND CONDUIT

Conduit shall be installed in conformance with Chapter 24 of these Standard Specifications.

Cable installed in conduits shall be installed in conformance with Chapter 24 of these Standard Specifications.

Aerial cable shall be installed in conformance with Chapter 24 of these Standard Specifications.

Direct burial cable shall be installed in a dug trench at a depth of 24" on rear lot lines and 30" on front and side lot lines unless obstructions interfere. Along the street the cable shall be installed approximately 5.5' from the sidewalk side of the curb unless otherwise specified. Use of an approved cable plow will also be permitted. In areas where trenching may permanently damage the health of mature plants, the boring procedure shall be required.

The cable shall be laid in a single piece from the source to the pole top or from one pole top to the next. No splices shall be permitted in the underground section of the cable. All splices, when required or necessary, are to be made in the base of the pole or in the pull box.

The cable shall be handled with care to avoid nicks or abrasions to the sheath. Any section of the cable which the City's Project Manager considers to be damaged shall be discarded.

Where necessary to clear permanent obstructions such as manholes, inlets, etc., the cable may be rerouted, but the City's Project Manager shall approve of such rerouting.

Electrical Connections shall be installed in conformance with Chapter 24 of these Standard Specifications. Care is to be given to ensure that all cable is installed within the designated easements.

The Contractor is responsible for notifying the property adjacent to any construction approximately 1 week prior to doing Work.

25.18 INSTALLATION OF PHOTOELECTRIC CONTROLS

All photoelectric controls shall be seated securely in the twist-lock receptacle and oriented so the "eye" window faces north. Orientation shall be made by means of adjustments provided by the manufacturer.

The Contractor shall plainly record the installation dates on photocells in the spaces provided by the manufacturer.

25.19 POWER SUPPLY AND RISER

Power supplies shall be installed at the locations shown on the plans. The power supply riser shall be 1 1/2". The riser shall be steel conduit a full 10' from the in ground 90 up without joints and shall be grounded. All pole risers shall be on stand off brackets provided by LES and can be picked up at LES Storeroom at the Walter Canney Service Center at 27th and Fairfield Streets, between 7:30 a.m. to 4:00 p.m. weekdays, with the exception of holidays. See LSP 83 for spacing detail. Power supplies from transformers or service pedestals shall be installed by the Contractor. The Contractor is responsible for contacting LES, to have LES energize or de-energize any Street Light Cable. Under no circumstance shall the contractor open any LES locked facilities, such as a Transformer or Pedestal.

25.20 TREE TRIMMING

Authorized tree trimming shall be done according to the direction of the City Forester. After trimming, all brush shall be hauled away and the area cleared of leaves and small twigs. Where required by City regulations, the services of a licensed Arborist shall be employed for tree trimming.

25.21 SECONDARY CONNECTIONS

When all Work has been completed and the luminaires are ready to be energized, the Contractor is responsible for contacting LES, to have LES energize or de-energize any Street Light Cable. Under no circumstance shall the contractor open any LES locked facilities, such as a Transformer or Pedestal.

25.22 REMOVING AND RESETTING MAILBOXES

Where rural type mailboxes interfere with cable installation adjacent to the curb, these shall be removed and reset to their original location not more than 2 days after removal. They must be available on the premises at all times in a position to receive mail. The Contractor shall make arrangements with the Post Office Station serving this area for details.

25.23 BASIS OF PAYMENT

Ornamental street lighting shall be measured and paid for on a per unit basis, complete, in place and accepted by the City's Project Manager. This price and payment shall be full compensation for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 26

COMMUNICATIONS

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CHAPTER 26

COMMUNICATIONS

26.00 GENERAL

A. MATERIAL TESTS

When any reference is made in these Special Provisions, or in the City of Lincoln Standard Specifications to a standard, such as ASTM, ICEA, IMSA, etc., or a related Specification referred to by reference therein, which states that a certain test is to be made only at the request of the purchaser, it shall be considered that the City does request that such test be made. The tests shall be made at the Contractor's expense and a certified copy of each test shall be submitted to the City's Project Manager prior to the installation of such material.

The Contractor shall submit to the City's Project Manager 1 hard copy and 1 electronic (pdf) copy of a complete list of all equipment and materials they intend to install. Catalog cuts and/or Manufacturers model number shall be required for the materials furnished by the Contractor and incorporated into the project. There shall be no substitutes for any of the items on the list without prior written approval of the City's Project Manager.

B. CONTRACTOR RESPONSIBILITY

The Contractor is responsible to inform the City's Project Manager of any defect found in the existing communications system encountered as part of this contract. Such defects may include, but not be limited to existing improper splices or existing damaged conduit. The City's Project Manager and Contractor shall determine a plan and cost to correct said defect.

The Contractor is responsible for locates within the project area, until the final inspection is complete.

C. SUBSTANTIAL COMPLETION

The communications system shall not be considered substantially complete until all items shown on the proposal or called for in any contract document are completed to the satisfaction of the City's Project Manager excluding seed/sod if outside planting season. The system shall be fully operational in conformance with the Plans and Standard Specifications and these or any other Special Provisions included as part of the project.

Liquidated damages shall continue to accrue until such time as the Work is deemed to be substantially completed by the City's Project Manager. However, the Contractor may submit a written request to the City's Project Manager for approval to suspend Work to allow additional time for completion of minor items of the Work. Granting the request for additional time by the City's Project Manager shall not relieve the Contractor of responsibilities for the completion of those items for which the suspension is requested.

26.00 GENERAL (Continued)

D. INSPECTION COMPLETION

Upon completion of a fully operational fiber optic communications system (including: locate system, fiber cable, and all communications equipment, where applicable), an inspection shall be completed by the City. The Contractor is allowed a defined number of calendar days to complete the following: correct any items as listed on the Inspection Form, return Inspection Form back to City, and correct any subsequent deficiencies identified by inspections until City accepts all work. The Contractor is responsible for providing an electronic format set of plans (as-built drawings) compatible with GIS and/or CAD format, detailing any changes made during construction from the original design. In addition, electronic format of any fiber optic communications system schematics, fiber splice diagrams, and cabinet equipment and connections shall also be provided in above-stated format as acceptable to the City of Lincoln.

Prior to the start of inspection, 1 hard copy and 1 electronic (pdf) copy of as-built plans shall be provided to the City. These as-built drawings shall be labeled "AS BUILT", with the Contractors initials and date.

The number of days for the inspection process is as follows: For the conduit system: 45 calendar days are allowed for the entire conduit system Inspection and Correction process. The City is allowed 14 calendar days for the initial inspection and 7 calendar days for each additional inspection needed thereafter.

Initial and subsequent City inspections shall be included as part of the calendar days allowed. If the Contractor has not corrected all items on the conduit Inspection form to the satisfaction of the City and has not received final acceptance from the City within the allotted time, the Contractor shall be assessed liquidated damages of \$500 per calendar day until all work is completed and deemed acceptable.

E. LOCATE SYSTEM

The locate system is comprised of ground rods, ground bars, fiber locate cable and fiber markers. This system is used by the locate technician to locate communication cables in conduits and indicate where fiber pull boxes are.

All locate system components shall be installed where indicated on the plans.

Ground Bars provide a field wiring terminal for the connection of Fiber Locate Cable.

F. TESTING

1. General

The overall communication system testing shall include a bare end fiber test after installation of the fiber optic cable, and a follow-on test after all final splicing and termination work is completed. On a per project basis, this test procedure may include measuring the loss of fiber installed by others before splicing to it. For each fiber optic link, including spare fibers, determine whether the optical loss is within the limits permitted by these specifications. A link is a continuous segment of fiber between one connector (or unterminated end) and another connector (or unterminated end). When testing links that do not have connectors on both ends, use a mechanical splice to attach a pigtail to the unterminated fiber for the duration of the test.

26.00 GENERAL (Continued)

G. TESTING (Continued)

1. General (Continued)

Acceptance Testing is incidental to the Fiber Optic Cable and will not be paid for separately.

2. Procedures

For each fiber link, follow this procedure:

If the link includes fiber installed by others, use an optical loss test set to measure and record the optical loss over that portion of the link before it is spliced to new fiber.

Calculate the maximum allowable loss for the completed link, both at 1310 nm and at 1550 nm. Use the following formula:

Maximum link loss = Measured loss over portion installed by others
+ (Fiber length in km) x (0.35 for 1310 nm and 0.25 for 1550 nm)
+ (Number of fusion splices) x (0.05)
+ (Number of mechanical splices [for temp. connection]) x (0.3)
+ (Number of connections) x (0.5)

Provide this calculation to the engineer along with the test results.

If the measured loss exceeds the calculated maximum, use an optical time domain reflectometer and other test equipment to troubleshoot the link. Take whatever corrective action is required, including cable replacement, to achieve a loss less than the calculated maximum.

Test Result Documentation. Prepare a diagram showing all of the links tested in this project. For the portions installed in this project, show the equipment cabinets, splices, and pigtails. On each line representing a link, show the maximum allowable loss and the actual loss. The actual loss shall be the one measured after all corrective actions have been taken. Submit an electronic copy of this diagram to the engineer, along with the calculations for the maximum allowable loss. Submit the diagrams and calculations in an electronic format acceptable to the engineer.

Documentation. Provide the engineer mark-ups of the plans, neat and legible, illustrating as-built versions of the splice and connection diagrams that are contained in the plans.

Certifications. The fiber optic cable shall be factory certified to meet the requirements in this specification. In addition, the manufacturer shall certify that the fiber optic cable has a life expectancy of 20 years.

Guarantee. All items covered by this specification shall carry a two-year guarantee from the date of acceptance against any defects in workmanship or materials.

26.01 BLANK ON PURPOSE

26.02 FIBER MARKER

A. GENERAL

Fiber Marker shall be a 66" long x 3.9"+, flexible fiberglass post with tapered triangular end for ground installation. Fiber Marker shall have 14" long x 2.8"+ label, that is non-reflective, outdoor-durable, vinyl, with "Warning, Fiber Optic Cable, City of Lincoln, Before digging in this area call 402-441-6855". Fiber Marker shall be standard APWA orange color, and have a post durability rating for 20+ years outdoor.

B. INSTALLATION

Fiber Marker shall be installed at locations as indicated on the plans by inserting the base end into the soil at a depth of 24", as per the manufacturer's recommendation. Fiber Marker shall be installed over the top of the fiber conduit as to depict the alignment of fiber conduit directly below the marker.

C. BASIS OF PAYMENT

FIBER MARKER, complete, in place and accepted by the City's Project Manager, shall be measured as a single unit and shall be paid for at the contract unit price per each for the item. This price shall be full compensation for furnishing and/or installing the fiber marker; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

26.03 BLANK ON PURPOSE

26.04 GROUND BAR

A. GENERAL

Ground Bar shall be 1-UL listed, ANSI Certified, CSA Listed. Ground Bar shall be 14 position. Ground Bar shall be insulated/isolated from the pull box utilizing plastic or nylon standoffs.

Ground Bars shall be all copper or aluminum construction, 6" L x 1/2" H x 1/4" W, with no less than 5 x 3/16" mounting holes. Grounding bar shall be mounted to the side of the pull box using standoffs and shall be placed no less than 6" from the ground rod and 10" from the bottom of the pull box lid.

B. INSTALLATION

Ground Bars shall be installed at locations as indicated on the plans and shall be mounted at the center point of the sidewall of the Pull Box T48 opposite the curb, 6" below the top rim. Ground Bar insulators will need to be mounted with 2 stainless steel machine screws through the sidewalls of the pull box, with 2 stainless steel washers on the outside of the pull box. Ground Bars shall then be mounted to the insulators such that they are insulated from the pull box.

C. BASIS OF PAYMENT

GROUND BAR, complete, in place and accepted by the City's Project Manager, shall be measured as a single unit and shall be paid for at the contract unit price per each for the item. This price shall be full compensation for furnishing and/or installing the ground bar; for standoffs; and for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

26.05 FIBER CABLES

A. TYPES AND CLASSES OF CABLE

All classes of cable shall be on substantially constructed reels, plainly marked as to size, type, and insulation identification. Only 1 length of cable shall be shipped on each reel. All cable must be new. Damaged cable or repairs on damaged cable will not be permitted. All cables shall be stranded copper.

1. Fiber Locate Cable

Fiber Locate Cable shall be a new single conductor #14 AWG type THHN 600-volt, stranded copper. Insulation jacket color shall be orange. UL 44 and UL 854, ICEA S-95-658/NEMA WC-70, C (UL) US Federal spec. A-A-59544. Fiber Locate Cable is incidental to the communications conduits installed and will not be paid for separately.

2. Single Mode Fiber Cable

All Single-Mode Fiber Cable fiber shall be single-mode conforming to ITU-T G652.D. Single-Mode Fiber Cable shall conform to ANSI/ICEA S-87-640 Standard for Optical Fiber Outside Plant Communications Cable. Cable type shall be non-armored, all Dielectric suitable for lashed aerial and duct installation. Single-Mode Fiber Cable shall contain water swellable tape to prevent water intrusion. Strength member of the Single-mode Fiber Cable shall be of a non-conductive type and shall provide strength sufficient for installation and residual loads. The cable sheath shall have length markings in feet, and shall indicate that the unit of measure is feet. The cable shall have an operating temperature range of -40 degrees C to 70 degrees C. Number of single-mode fibers within the Single-mode Fiber Cable shall be specified on the project plans. The cables shall be constructed with twelve fibers per tube.

All fibers shall be suitable for transmission using both 1310 nm and 1550 nm wavelengths. Attenuation shall not exceed 0.35 dB/km and 0.25 dB/km for 1310 nm and 1550 nm signals, respectively.

B. INSTALLATION

1. Fiber Locate Cable

Each locate cable shall be terminated at the conductor terminals on the insulated, isolated Ground Bar affixed to the inside of the pull box and to the ground buss in the cabinet.

2. Single Mode Fiber Cable

Single-Mode Fiber Cables shall be installed in such a manner and by such methods ensuring against harmful stretching of the optical fiber, injury to the jacket, damage to the outer protective covering of the cable, or cable crushing. An approved cable lubricant may be used to aid in pulling through conduit.

26.05 FIBER CABLES (Continued)

B. INSTALLATION (Continued)

2. Single Mode Fiber Cable (Continued)

To provide proper slack in cable, 50' of extra fiber cable shall be neatly coiled and secured in each pull box with Velcro fasteners. For pull box locations with Splice Enclosures, this means 25' of additional cable on each side of the Splice Enclosure for a total 50' of slack. Under no circumstance shall any cable be taped or otherwise bound to another cable. Fiber cable shall be installed in conduit with a suitable cable feeding method to protect the cable and guide it into the duct. Break away pulling swivels rated at 600 lbs. shall be used to ensure that the maximum tensile force for the cable is not exceeded and to prevent cable twisting. Ensure that no residual tension remains on the cable after installation, except the weight of the cable.

Do not install conductors carrying AC power in the same wiring harness as cables carrying control or communications signals.

No splices or joints will be permitted to be drawn inside the conduit, nor shall any splices or joints be made in any cable outside of pull boxes or cabinets.

Single-Mode Fiber Cable shall be installed within the ambient temperature limits specified by the manufacturer.

Arrange all fiber cabling, including fiber optic pigtails, so that any removable assembly can be removed without disturbing cabling that is not associated with the assembly being removed.

Prior to installation, perform such tests as indicated in this provision to confirm that the cable is in good condition and complies with the specifications. Any defects found after installation will be deemed the fault of the contractor.

Install the cable such that the optical and mechanical characteristics of the fiber are not degraded. Do not violate the minimum bend radius or the maximum tension, both during and after installation. During cable installation, keep the bend radius at a minimum of twenty times the outside diameter of the cable.

Cables shall be neatly coiled in fiber optic pull boxes and hung on cable racks as available for organized storage and ease of future access.

Before any cable installation is performed, provide the engineer with a copy of the cable manufacturer's recommended maximum pulling tensions for each cable size. These pulling tensions shall be specified for pulling from the cable's outer jacket. Also, provide a list of the minimum allowable cable bending radius and the cable manufacturer's approved pulling lubricants. Only those lubricants approved by the cable manufacturer will be permitted.

If the cable is pulled by mechanical means, use a clutch device to ensure the allowable pulling tension is not exceeded. Also, attach a strain gauge to the pulling line at the cable exit location, and at a sufficient distance from the take-up device, such that the strain gauge can be read throughout the entire cable pulling operation.

26.05 FIBER CABLES (Continued)

B. INSTALLATION (Continued)

2. Single Mode Fiber Cable (Continued)

Do not leave the let-off reel unattended during a pull, in order to minimize the chance of applying excess force, center pull, or back feeding.

Use an approved lubricant, in the amount recommended by the cable manufacturer, to facilitate pulling the cable. After the cable has been installed, wipe the exposed cable in a pull box, junction box, or cabinet clean of cable lubricant with a cloth before leaving the pull box, junction box, or cabinet. After installation, cut off and discard the first 10 feet of the cable. These 10 feet are not included in the quantities and are considered incidental to the fiber work. Seal the fiber optic cable ends to prevent the escape of the filling compound and the entry of water.

All fiber optic cables installed in pull boxes or cabinet locations shall be neatly and definitively labeled using fiber cable tags provided by the City of Lincoln. These fiber optic cable tag labels shall be labeled by the contractor with the number and direction of fiber cables (to/from) and which fibers are spliced, if any.

All fiber optic cable new or relocated shall be tested by the Contractor with an Optical Time Domain Reflectometer (OTDR). Testing shall be performed after all connectors are complete if the Contractor is expected to perform the connectorization. If the contractor is not expected to perform the connectorization then a bare end test of the fiber shall be performed to test cable integrity after contractor installation. In the case of separate contractors for Fiber Optic Cable install and Fiber connectorization an additional OTDR test will be required of the connectors by the connector contractor after all specified connectors are complete. Testing of fiber optic cable shall be conducted in conformance with the Acceptance Testing section of these provisions.

C. BASIS OF PAYMENT

CABLE, FIBER OPTIC, ___ STRAND, SINGLE MODE complete, in place and accepted by the City's Project Manager shall be measured as lineal feet from center to center of pull boxes, cabinets, or enclosures plus slack coil amounts furnished and installed as specified on the plans of such material of the size and type required and number of fibers. Cable shall be paid for at the contract unit price bid per linear feet.

This price and payment shall be full compensation for furnishing and installing cable, all necessary slack, testing, documentation, connections and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.

Additional slack cable required inside pull boxes, cabinets, and other such devices or structures, not quantified or indicated on the plans shall be subsidiary to those items and shall not be measured for payment.

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES

A. COMPONENTS

1. Fiber SC Connector

All Fiber SC Connectors shall be temperature rated for -40 C to 70 C or better, and shall be compliant with ANSI/TIA-568-B.3 and TIA/EIA-604-3. Fiber SC Connectors shall be SC type compatible with single-mode fiber and shall be terminated using an appropriate Fiber Fan Out Kit. Fan Out Kits are incidental to fiber termination work.

All Fiber SC Connectors shall be installed using the method recommended by the connector manufacturer, and shall be installed compatible with both Fiber Distribution Rack Mount Enclosures, and Fiber Distribution Wall Mount Enclosures.

2. Fiber SC Panel Pigtail

Fiber SC Panel Pigtail shall be temperature rated for -40 °C to 70 °C and shall conform to Design and Test Criteria GR-3152, GR-771. Fiber SC Panel Pigtail shall have 12 SC UPC single mode ports in a housing with an outdoor single mode pigtail of appropriate length for the application. Fiber SC Panel Pigtail shall be wall, or din rail mountable.

3. Fiber Optic Cable Fusion Splice

When a buffer tube is required to be opened in order to perform fusion splicing, cut only the fibers to be terminated/spliced at a location according to the Plans. Unused fibers or fibers that are continuous through a splice location (expressed fibers) are to be coiled, and neatly routed around the inside edges of the splice tray. Fusion splicing will ensure alignment is via fiber cores and splicing equipment shall be fully automated X, Y, and Z axis (3-axis) alignment using a light injection/detection system. Use splicing equipment that has an auto fusion time control to monitor the power level through the splice to complete the fusing process when splice loss is a minimum. Provide splice losses that average less than or equal to 0.05dB/splice between any two optical ports, and do not exceed the same level for any splice. Protect all splices with a thermal shrink sleeve, 60 mm long. Place the completed splices in a splice tray.

4. Fiber Optic Cable Splice Enclosures

Fiber Optic Splice Enclosures shall be listed in the latest edition of the Rural Utilities Service (RUS), List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers, category pl, closure design e, suffix B; or be of brand Coyote Fiber Optic Closures, or approved equal. They shall include all materials necessary to make, organize, and protect the splices.

Fiber Optic Splice Enclosure housing shall be non-metallic resistant to solvents, stress cracking, and creep.

Fiber Optic Splice Enclosure shall be re-enterable not requiring encapsulation or potting to resist water penetration.

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES (Continued)

A. COMPONENTS (Continued)

4. Fiber Optic Cable Splice Enclosures (Continued)

The Fiber Optic Splice Enclosure shall be of a size sufficient to accommodate the number of Single-Mode Fiber Cables and splices specified on the project plans. Fiber Optic Splice Enclosures shall be furnished and installed as either “small” or “large” as defined on the project plans and specs. Fiber Optic Splice Enclosure, Small; shall be able to accommodate a minimum of 48 splices. Fiber Optic Splice Enclosure, Large; shall be able to accommodate a minimum of 144 splices. The Fiber Optic Splice Enclosure shall provide a clamping mechanism to prevent pistoning of the central strength member and to prevent cable sheath pullout.

The Fiber Optic Splice Enclosure shall have appropriate hardware and installation procedures to facilitate the bonding and grounding of metal components in the enclosure and the armored cable sheath. The cable bonding hardware shall be able to accommodate a copper conductor equal to or larger than a No. 6 AWG.

The Fiber Optic Splice Enclosure shall accommodate and include splice trays suitable for single fiber, single fiber heat shrink, mechanical, or ribbon heat shrink splices, and shall accommodate the number of splices specified in the project plans.

A bond clamp shall remain firmly attached to the cable armor sheath while under a tensile load of 9-kg (20 lbf). Following removal of the load, there shall be no evidence of clamp loosening or damage to the cable sheath, armor, or clamp that would reduce its current carrying capacity as required by the AC fault test.

The electrically conductive path used for continuity and grounding of the splice enclosure metallic components shall be capable of withstanding an AC current of 1000 Amperes for 20 seconds.

The cable clamping and sealing hardware used to terminate optical fiber cable shall not cause an attenuation change greater than ± 0.05 dB per fiber, when tested with a source operating at $1550\text{nm} \pm 20\text{nm}$.

An axial load of 100 lbf, individually applied to each cable, shall not cause mechanical damage to the cable or clamping hardware. The load to the optical fiber cable shall not cause an attenuation change greater than ± 0.05 dB per fiber, when tested with a source operating at $1550\text{nm} \pm 20\text{nm}$.

Subjecting the closure/cable interface to 90° flexing for 8 cycles at ambient temperatures of $-18^\circ\text{C} \pm 2^\circ\text{C}$ ($0^\circ\text{F} \pm 3.6^\circ\text{F}$) and $40^\circ\text{C} \pm 2^\circ\text{C}$ ($104^\circ\text{F} \pm 3.6^\circ\text{F}$) shall not cause any mechanical damage to the cable or clamping hardware. In addition, flexing of the optical fiber cable shall not cause an attenuation change greater than ± 0.05 dB per fiber, when tested with a source operating at 1550 ± 20 nm.

Subjecting the closure/cable interface to 10 cycles of torsional loading at ambient temperatures of $-18^\circ\text{C} \pm 2^\circ\text{C}$ ($0^\circ\text{F} \pm 3.6^\circ\text{F}$) and $40^\circ\text{C} \pm 2^\circ\text{C}$ ($104^\circ\text{F} \pm 3.6^\circ\text{F}$) shall not cause any mechanical damage to the cable or clamping hardware. In addition, torsional loading of the optical fiber cable shall not exceed allowable attenuation changes.

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES (Continued)

A. COMPONENTS (Continued)

4. Fiber Optic Cable Splice Enclosures (Continued)

The enclosure shall not exhibit any mechanical damage after being subjected to a vertical drop from a height of 0.75 m (30") at temperatures of $-18^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($0^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) and $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($104^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$).

The diameter of the optical fiber splice enclosure shall not permanently deform more than 10%, nor temporarily deform more than 20%, when it is compressed by a uniformly distributed load of 300 lbf. Additionally, the compressive load shall cause no mechanical damage to the enclosure or its contents.

The enclosure shall not exhibit any mechanical damage after being subjected to mechanical impact of 100 lbf (136 Nm) at temperatures of $-18^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($0^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) and $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($104^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$).

The enclosure central member clamp shall prevent movement (e.g. bowing, pistoning, or breaking) of the cable central member (CM) when the CM exerts a force of 100 lbf on the clamp.

Sealing components (gaskets, grommets, O-rings) used in an enclosure, shall not permit the entry of water into the enclosure after thermal aging at $90^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ($194^{\circ}\text{F} \pm 1.8^{\circ}\text{F}$) for 720 hours (30 days).

The enclosure shall be capable of safe and proper assembly at temperatures of $0^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($32^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) and $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($104^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) using materials and procedures specified by the manufacturer.

The enclosure shall not exhibit any mechanical damage or corrosion following 30 days of severe temperature and humidity cycling from $65^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($150^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) and 95% relative humidity to $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ($-40^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$) and uncontrolled humidity. Additionally, at the midpoint of the temperature cycle, re-entry and re-assembly of the enclosure shall be done. If the enclosure has a hinged cover, it shall be flexed 25 times.

The enclosure shall show no evidence of water intrusion into the compartment containing fiber splices after it is immersed in water and subjected to 10 freeze/thaw cycles.

The splice enclosure shall show no evidence of water penetration following exposure to a 20' waterhead for a period of 7 days.

An enclosure shall show no evidence of corrosion following exposure to acidified saltwater for a period of 90 days.

The enclosure shall show no change in sealing ability after submersion in a specified chemical test fluid for 7 days. The mechanical integrity of the enclosure shall be confirmed by performing the compression and impact tests. The enclosure seal shall also be checked by performing the water immersion test. Additionally, samples of external, nonmetallic enclosure materials shall neither experience a change in weight greater than 10%, nor experience a reduction in tensile strength or elongation properties greater than 20%, after immersion in the chemical test fluid.

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES (Continued)

A. COMPONENTS (Continued)

4. Fiber Optic Cable Splice Enclosures (Continued)

Samples of external, nonmetallic enclosure materials shall not have a reduction in tensile strength or elongation properties greater than 20% of their original value, after being exposed to a UV-B type ultraviolet light source with a peak emission at 313 nm for 2,160 hours (90 days).

Samples of polymeric enclosure materials shall not support fungus growth when tested per ASTM G 21. A rating of 0 is required.

5. Fiber Distribution Wall Mount Enclosure

Fiber Closet Connector Housing shall be a wall mountable housing capable of housing 4 Fiber SC Closet Pigtails. Closet Connector Housing shall be compatible with SC Closet Pigtails. Closet Connector Housing shall have storage for appropriate splice trays. Closet Connector Housing shall have a hinged door to provide convenient access to installed SC Closet Pigtails and splice trays.

6. Fiber Distribution Rack Mount Enclosure

Fiber Rack Mount Connector Housing shall be a 19" rack mountable housing capable of housing 4 SC Closet Pigtails. Fiber Rack Mount Connector Housing shall be compatible with SC Closet Pigtails. Closet Connector Housing shall have storage for appropriate splice trays. Rack Mount Connector Housing shall have a hinged door to provide convenient access to installed SC Closet Pigtails and splice trays.

7. Factory Terminated Patch Panel w/ Pigtail

Factory terminated patch panels with pigtails will provide for connectivity between field cabinets and fiber optic cable in pull boxes. The factory terminated end will be mounted in the traffic signal or ITS cabinet, and the opposite end of the pigtail shall be spliced in the Fiber Splice Enclosure located in the T48. A fiber splice schematic indicating the fusion splice plan will be provided by the City. The factory terminated patch panels with pigtails shall be provided in either 4-step, skinny (8 fiber port) or 6-step, skinny (12 fiber port) configurations and have type SC connectors. They shall have the following characteristics:

Test	Single mode
Test wavelength	1550nm
Insertion loss	0.2dB typical, 0.5dB max.
Reflectance	<-55dB (apc connector)
Durability	500 matings, <0.2dB change
Tensile strength - straight pull (cable tail)	50lbs (220N), <0.2dB change
Temperature range	-40 to +70C
Ferrule polish	UPC
Connector Type	SC

The Factory Terminated Patch Panel w/ Pigtail, whether 4-step or 6-step, shall be provided with a minimum pigtail length of 75' unless otherwise noted in special cases.

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES (Continued)

A. COMPONENTS (Continued)

8. Junction Box

Junction Box shall be 2' x 2' x 6" Powder coated steel. Junction Box shall be NEMA 3R rated and shall be lockable.

9. 3", 3 Cell Fabric Innerduct

3", 3 Cell Fabric Innerduct shall be 3", 3 cell polyester/nylon textile innerduct. Fabric Innerduct shall be capable of accommodating up to a 1" diameter cable per cell. Fabric Innerduct shall contain 1250 lb. polyester flat woven pull tape.

B. INSTALLATION

1. Fiber SC Connector

For Single-Mode Fiber Optic Cable the below table specifies minimum acceptable SC Connector performance:

Loss Mode	Maximum Acceptable Loss (dB)
Single-Mode SC connector (dB loss/connector)	.50 dB max

All OTDR test shall be performed using appropriate launch and receive cables. OTDR submitted test results shall use the full scale of the OTDR display, shall include 2 point loss from launch cable to launch cable, and shall include Optical Return Loss. When testing connectors, a 2 point loss measurement across the connector shall be performed. All testing shall be performed at 1310nm and 1550nm wavelengths.

2. Fiber SC Panel Pigtail

SC Panel Pigtail shall be securely installed where indicated on plans. SC Panel Pigtail shall be mounted in such a way so as to allow easy access. SC Panel Pigtail shall be spliced into existing fiber using a fusion splice. Finished splice shall be housed in a Fiber Splice Enclosure. After installation the SC Panel Pigtail shall be tested with an Optical Time Domain Reflectometer using appropriate launch and receive cables. SC Panel Pigtail shall meet or exceed the below parameters:

Loss Mode	Maximum Acceptable Loss (dB)
SC Connector Insertion Loss (Per Connector)	.50 dB Max
SC Panel Pigtail Fusion Splice (Per Splice)	≤ 0.30 Db

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES (Continued)

B. INSTALLATION (Continued)

3. Fiber Optic Cable Fusion Splice

Fiber Optic Cable Fusion Splice shall be cleaved, cleaned, aligned and spliced according to the fiber splice machine specifications.

Splice shall be protected with either Butterfly or heat shrink splice protection and shall be secured in a splice tray designed for fusion splices

4. Fiber Optic Cable Splice Enclosure

Installation of Fiber Optic Cable Splice Enclosure shall follow manufacturer's directions. Installation of Fiber Optic Cable Splice Enclosures in underground Fiber Pull Boxes shall be done in conformance to manufactures directions. Fiber Optic Cable Splice Enclosure shall be neatly hung within the T48 pull box along with excess fiber coils. No Fiber Optic Cable Splice Enclosures shall be permitted for direct burial or in conduit splicing.

5. Fiber Distribution Wall Mount Enclosure

Fiber Distribution Wall Mount Enclosure shall be securely installed where indicated on plans and shall use appropriate mounting hardware. Closet connector housing shall be mounted in such a way as to provide easy access to connector housing access door and the connection points.

6. Fiber Distribution Rack Mount Enclosure

Fiber Distribution Rack Mount Enclosure shall be securely installed where indicated on plans and shall use appropriate mounting hardware. Rack Mount Enclosure shall be mounted in such a way as to provide easy access to components, doors and connection points as mounted within ITS cabinets.

7. Factory Terminated Patch Panel w/ Pigtail

Installation of the Pigtails shall follow manufacturer's instructions.

8. Junction Box

Junction Box shall be installed where indicated on plans and shall be securely fastened to building using 4 fastening points. Building entrances shall be PVC conduit of a size specified on the plans and shall use weather tight bulkheads on all entrances to the Junction Box. All entrances to building shall be sealed with mastic to prevent water intrusion.

9. 3", 3 Cell Fabric Innerduct

Fabric Innerduct shall be installed from Pull Box to Pull Box or where specified on plans using continuous unspliced lengths. Fabric Innerduct shall be installed using the manufacturers specified installation procedure. After installation, Fabric Innerduct and pull tape shall be secured following the manufacturer's recommended method.

26.06 FIBER CONNECTORS, ENCLOSURES AND ACCESSORIES (Continued)

C. BASIS OF PAYMENT

FIBER SC CONNECTOR; FIBER SC PANEL PIGTAIL; FIBER OPTIC CABLE FUSION SPLICE; FIBER OPTIC CABLE SPLICE ENCLOSURE, ____; FIBER DISTRIBUTION WALL MOUNT ENCLOSURE; FIBER DISTRIBUTION RACK MOUNT ENCLOSURE; FACTORY TERMINATED PATCH PANEL W/PIGTAIL, ____-STEP and JUNCTION BOX, 2' X 2' complete, in place and accepted by the City's Project Manager, shall be measured as a single unit and shall be paid for at the contract unit price bid per each. This price and payment shall be full compensation for furnishing and installing the items; and for all labor, equipment, tools, materials, and incidentals required to complete the Work.

For City of Lincoln furnished items: FIBER SC CONNECTOR, INSTALL; FIBER SC PANEL PIGTAIL, INSTALL; FIBER OPTIC CABLE SPLICE ENCLOSURE, ____, INSTALL; FIBER DISTRIBUTION WALL MOUNT ENCLOSURE, INSTALL; FIBER DISTRIBUTION RACK MOUNT ENCLOSURE, INSTALL and FACTORY TERMINATED PATCH PANEL W/PIGTAIL, ____-STEP; complete, in place and accepted by the City's Project Manager, shall be measured as a single unit and shall be paid for at the contract unit price bid per each. This price and payment shall be full compensation for installing the items as provided by City of Lincoln; and for all labor, equipment, tools, materials, and incidentals required to complete the Work.

3", 3 CELL FABRIC INNERDUCT, complete, in place and accepted by the City's Project Manager, shall be measured as lineal feet from center to center of pull boxes, or where specified on plans, of such material of the size and type require and shall be paid for at the contract unit price bid per linear feet. This price and payment shall be full compensation for furnishing and installing 3", 3 Cell Fabric Innerduct, pulling tape, all necessary slack, documentation; and for all labor, equipment, tools, materials, and incidentals required to complete the Work.

26.07 INSTALL ITS FIELD SWITCH

A. GENERAL

ITS Field Switch shall be a field-hardened, Ethernet switch provided by the City of Lincoln for installation in cabinet locations as part of Traffic Signal and ITS projects as indicated on the plans.

B. INSTALLATION

ITS Field Switch shall be installed at locations shown on the plans. Unless otherwise specified, the units shall be shelf-mounted in cabinets as indicated, for applicable connections to communications cable and equipment. Switches will be pre-programmed by City of Lincoln, Traffic Operations, with relevant SFP modules for installation. Proper power supplies shall also be installed on din rails, and will be provided by City of Lincoln for contractor installation.

C. BASIS OF PAYMENT

INSTALL ITS FIELD SWITCH, complete, in place, and accepted by the City's Project Manager, shall be measured for payment as single units and shall be paid for at the contract unit price bid per each for the item only when called for. This price and payment shall be full compensation for picking up and installing ITS Field Switch, all labor, equipment, tools, and incidentals necessary to complete the Work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 30

SEEDING AND SODDING

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CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 30

SEEDING AND SODDING

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CHAPTER 30

SEEDING AND SODDING

30.00 DESCRIPTION

The Work described in this section shall pertain to any seeding, sodding or turf plugging work.

Work shall include all labor, material and equipment as herein specified. The Work shall comply with the requirements of all legally constituted authorities having jurisdiction.

This Work shall consist of furnishing, delivering and planting of plant material and all operations incidental thereto, in conformance with Lincoln Standard Plans, the Special Provisions, and these Standard Specifications

30.01 QUALITY ASSURANCE

Contract sodding work to a single firm specializing in sodding and growing of turf grass. Firm shall have satisfactory record of performance on completed projects of comparable size and quality.

Contract seeding work to a single firm specializing in seeding turf and/or wildflower mixes. Firm shall have satisfactory record of performance on completed projects of comparable size and quality.

Contract plugging work to a single firm specializing in plugging grass. Firm shall have satisfactory record of performance on completed projects of comparable size and quality.

Contractor must comply with American Sod Producers Association Classes of sod materials.

The City's Project Manager may inspect sod, seed or plugs at site before planting, for compliance with requirements for genus, species, variety, size and quality. The City's Project Manager may reject unsatisfactory or defective material at any time during progress of Work. Rejected materials shall be immediately removed from project site.

Submittals

Certificate of Inspection: Submit certificates of inspection as required by governmental authorities.

Certified Analysis: Submit manufacturer's certified analysis, or, where applicable, Analysis of recognized laboratory made in conformance with methods established by the Association of Official Agriculture Chemists. Include soil amendments and fertilizer materials.

List of Sources: Submit a written list of the supplies where the material was produced. Materials from unapproved sources will be rejected.

30.02 SOURCE QUALITY CONTROL

Ship materials with certificates of inspection required by governing authorities. Comply with regulations applicable to sod, seed and materials.

Do not make substitutions. If specified sod, seed and other materials are not obtainable, submit proof of non-availability to City's Project Manager.

Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in conformance with methods established by the Association of Official Agriculture Chemists, wherever applicable. The actual planting shall be performed during those times in this season which are normal for such Work as determined by weather conditions, and accepted practice in the locality.

30.03 PLANTING SEASON

Within 30 days after receiving the signed contract, the Contractor shall submit a written list of the nurseries from whom the Contractor will purchase the materials, and the source where the material was produced. The list shall be submitted to the City's Project Manager. The Contractor will be notified if there are any unapproved sources of materials on the list. Materials from unapproved sources will be considered for rejection.

The planting season for all material shall be:

SEED	April 15 - May 15. August 15 - October 1.
DORMANT SEEDING	December 1 – March 1.
SOD	March 1 to June 15, and September 1 to October 15.
PLUGS	May 1 to August 1. Soil temperatures must consistently be above 60 degrees F (16 degrees C).

Sodding/Seeding/Plugging operations shall be performed during this time period only, except when prior written permission is obtained from the City's Project Manager. The actual sodding/seeding/plugging shall be performed during those times in this season which are normal for such Work as determined by weather conditions, and accepted practice in the locality.

30.04 MATERIALS (GENERAL INFORMATION)

A. GENERAL PLANT MATERIALS REQUIREMENT

1. All material shall comply with all applicable State and Federal laws, including inspection certifications which shall include the project number and the plant material that the certification covers. All material is subject to inspection by representatives of the City, State and Federal Governments.
2. All material furnished shall be true to name and type and legible labels shall be furnished to ensure all species, varieties, boxes, bundles, bales or other containers are identified. The information on the label shall cover the botanical genus, species, and common name or variety.
3. All material shall be sound, healthy specimens and first-class representatives of their species or variety, and shall have well formed tops and healthy root systems.

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

A. GENERAL PLANT MATERIALS REQUIREMENT (Continued)

4. Materials which are planted and later discovered to be not true to name may be allowed to remain in place as approved by the City's Project Manager without payment being made therefore.
5. A representative sample of all material shall be submitted to the City's Project Manager for approval prior to planting if requested.
6. Any material that is planted which does not meet the specified minimum size shall be rejected or allowed to remain in place without payment being made therefore.
7. If a Contractor is unable to locate sufficient material in specified sizes, negotiation for unit price reduction shall be concluded prior to installation.
8. All material shall be true to species and variety specified and grown/produced in conformance with good horticultural practices.
9. Substitution of specified materials shall not be permitted unless authorized by the City's Project Manager.

B. SEED (GENERAL)

1. All seed shall be certified blue tag seed unless otherwise specified.
2. All seeds shall comply with the applicable State and Federal seed laws.
3. Seed used shall be free of crop, weed and inert matter.
4. The Contractor shall obtain from the seed dealer and furnish to the City's Project Manager an analysis of each type and lot of seed the Contractor proposed to use.
5. The analysis shall provide complete information on the seed as required by the State and Federal laws, as well as the specific crop and noxious weed seed present.
6. The City's Project Manager may approve use of the seed if the information on the analysis is satisfactory. A minimum of 85% pure live seed (purity x germination x 100) is required for approval. Grass seed mixtures shall comply with the formulas provided in the seeding tables.

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

B. SEED (GENERAL) (Continued)

Listed below are Standard Specifications for each type of grass seed mixture. Included in each Standard Specifications are the grasses which are approved for use in that mixture. Other cultivars may be approved by the City's Project Manager provided they are recommended by the most current NebGuide, titled "Choosing grasses and buying seed for lawns in Nebraska and the Northern Great Plains", published by the Cooperative Extension Service of the University of Nebraska at Lincoln, or by the Extension Turfgrass Specialist.

Note: Seeding period is as listed under 30.03 Planting Season unless specifically noted under the Approved Type of Variety (i.e. Type C and J).

APPROVED VARIETIES INCLUDE:

TYPE "A" - Lawn Mix (High maintenance turf, sunny locations)

For use in sunny locations receiving higher maintenance, water on a regular basis and requiring adequate appearance and rapid establishment.

Kentucky Bluegrass Blend

Description:	Dark green color, good shade tolerance, disease resistant
Location:	Sites with irrigation, Office Parks, Residential
Composition:	15.68% Everest, 15.68% Blue Note, 15.68% Rubicon, 15.68% Rugby II, 15.68% Rush, 9.80% Goalkeeper II, 9.80% LaQuinta or equivalent mixture
Notes:	All turfgrass seed must be blue tag certified unless otherwise specified. All turfgrass seed blends/mixtures must be interagency blue tag certified unless otherwise specified.
General Application:	Seed 2 to 3 lbs. /M Sq. Ft.
Overseed Application:	Overseed 1 to 1 ½ lbs. /M Sq. Ft.

TYPE "B" - Fescue Mix (Medium maintenance turf, sunny locations)

For use in sunny locations receiving medium maintenance and requiring adequate appearance and rapid establishment.

Turf Type Tall Fescue, Kentucky Bluegrass and Perennial Ryegrass Mix

Description:	Lower growing dwarf fescue, high wear tolerance, low
Location:	Parks and lower maintenance areas with or without irrigation. Mowing required.
Composition:	22.05% Firecracker SLS, 22.05% Monet, 22.05% Spyder LS, 22.05% Turbo, 3.67% Jackpot, 3.67% NuBlue Plus or equivalent mixture.
Notes:	All turfgrass seed must be blue tag certified unless otherwise specified. All turfgrass seed blends/mixtures must be interagency blue tag certified unless otherwise specified.
General Application:	Seed 8 to 10 lbs. /M Sq. Ft.
Overseed Application:	Overseed 4 to 5 lbs. /M Sq. Ft.

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

B. SEED (GENERAL) (Continued)

TYPE “C” - Buffalo grass (Low maintenance turf in sunny locations)

For use in sunny locations receiving little or no supplement water beyond establishment and requiring minimal mowing.

Buffalo grass cultivars including: Legacy, Cody, Bowie, Bison, Texoka, Tatanka, Prestige, Top Gun

Description: Low growing, 4" - 8" little or no mowing
Location: Medians, Boulevards, Open Space areas
Seeding Period: May 1 – September 10
Composition: Varies between species
General Application: Apply 2 to 3 pounds of seed per 1000 sq. ft.
Overseed Application: Apply 1 to 2 pounds of seed per 1000 sq. ft.

TYPE “D” - Shade Mix (For use in shady locations)

For use in areas receiving little or no sun.

Description: Versatile mix of fescues, fairly low maintenance
Location: Residential, older areas of town (i.e. Capitol Environs District)
Composition: MX 86 Sheeps Fine Fescue, Rescue 911 hard Fine Fescue, SR3200 Blue Fine Fescue, Jamestown Chewings Fine Fescue and Rose creeping Red Fine Fescue or equivalent(s).
General Application: Apply 4 to 6 Lbs. /M Sq. Ft.
Overseed Application: Overseed 2 to 4 Lbs. /M Sq. Ft.

TYPE “E” - Low Growing Grass Mix (Outlying City and Acreages)

For use in areas requiring low maintenance, low growing, natural native prairie look

Description: Mixture of cool and warm season grasses
Location: Outlying areas of town, acreages:
Composition: Blue Fine Fescue, hard Fine Fescue, Sheeps Fine Fescue, Blue Grama, Little Bluestem and Sideoats Grama
General Application: Seed 16 to 32 Lbs. /Ac (1/2 to 1 Lb. /1,350 Sq. Ft.).
Overseed Application: N/A

TYPE “F” - Rural Mix (County Road and Rural NRD Projects)

For use in sunny rural locations and along roadsides for quick growth and erosion control.

Description: Strong sod forming abilities of brome grass with deep rooting fescue
Location: County Roads, Rural NRD Projects
Composition: See Below
General Application: Smooth Brome grass, VNS 10 lbs pls/acre
Oats, Jerry 20 lbs pls/acre
Hairy Vetch 2.25 lbs pls/acre
Clover, Mammoth Red, VNS 2.25 lbs pls/acre
Switchgrass, NE 28 2.25 lbs pls/acre
18-46-0 Fertilizer 200 lbs/acre
Zinc Sulfate Monohydrate 20 lbs/acre
Overseed Application: N/A

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

B. SEED (GENERAL) (Continued)

TYPE “G” - Native Prairie Mix

For use in sunny locations, low maintenance and taller grasses are acceptable.

Description: Mixture of 5 native warm season grasses
Location: Native Prairie, Natural Areas
Composition: 2.0 PLS Lbs. Big Bluestem, 1.5 PLS Lbs. Each of Little Bluestem and Indiangrass, 1.0 PLS each of Canada and Virginia Wild Rye and 0.6 PLS Lbs. each of Switchgrass and Sideoats Grama.
General Application: Apply 20 pounds per acre.
Overseed Application: N/A

TYPE “H” - Flood Plain Mix (For use in drainage channels and on channel side slopes)

For use in sunny locations with tolerance to standing water from 14 to 60 days.

Description: Mixture of deep-rooted grasses for wetlands
Location: This mixture may be used along shorelines, dams and lowland pastures
Composition: Big Bluestem, Canada Wildrye, Red Top, Virginia Wildrye, Switchgrass and Western Wheatgrass
General Application: Seed 15 - 20 Lbs. /Acre
Overseed Application: N/A

TYPE “I” - Waterway Mix

For use in areas required to conform to the county ASCS Specifications for waterways.

Description: Mixture blended for waterways
Location: Waterways, Right-of-Way ditches, lowland pastures
Composition: 57% Smooth Brome grass, 11.50% Orchardgrass, 11.50% Tall Fescue and 20% Switchgrass.
General Application: Apply 24 Lbs. /Acre
Overseed Application: N/A

TYPE “J” - Short Grass Prairie Mix

For use in sunny locations where low maintenance and mid-height grasses are acceptable.

Description: Mixture of 4 native warm season grasses
Location: Native Prairie, Natural Areas, Parks
Seeding Period: May 1 – May 30; December 1 – March 1
Composition: Buffalograss, Blue Gramma, Sideouts Gramma; Little Bluestem
Notes: All turfgrass seed must be blue tag certified unless otherwise specified. All turfgrass seed blends/mixtures must be interagency blue tag certified unless otherwise specified.
General Application: Apply: Broadcast 1PLS Lb./3000 sq. ft. or Drilled: 8 PLS Lbs./Acre
Overseed Application: N/A

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

C. SOD (GENERAL)

1. Sod shall be taken from sources approved by the City's Project Manager.
2. The sod shall be a first-class representation of normal cultivars of bluegrass, fescue, buffalo grass.
3. The Contractor shall furnish to the City's Project Manager, upon request, a list of the cultivars used to produce the sod.
4. Sod shall be uniform in color and quality and shall be free of weeds, diseases or other visible imperfections at the time of acceptance.
5. The sod shall be mowed and raked to remove stems, sticks and grass clippings prior to cutting.
6. The sod shall be cut to a depth of approximately 3/4". Extreme care shall be taken in cutting, handling, transporting and laying the sod to avoid unnecessary damage to and loss of earth from roots of the sod.
7. Sod shall not have dry or dead edges.
8. Certified sod, if requested, shall have been inspected and approved by the State Certifying Agency.

APPROVED VARIETIES INCLUDE:

Rhizomatous Tall Fescue
Turf Type Tall Fescue
Bluegrass/Fescue Blend
Buffalo grass (Legacy, Cody, Bowie, Bison, Texoka, Tatanka, *Prestige, Top Gun*)

D. GRASS PLUGS (GENERAL)

1. Grass plugs shall be taken from sources approved by the City's Project Manager.
2. The plugs shall be a first-class representation of normal cultivars of specified grass.
3. The Contractor shall furnish to the City's Project Manager a list of cultivars used to produce the plugs.
4. Grass plugs shall be uniform in color and quality and shall be free of weeds, disease or visible imperfections at the time of acceptance.
5. Extreme care shall be taken in cutting, handling, transporting and placing the plugs to avoid unnecessary damage to and loss of earth from the roots of the plugs.

APPROVED VARIETIES INCLUDE:

Buffalo Grass (Legacy, Cody, Bowie, Bison, Texoka, Tatanka, *Prestige, Top Gun*)

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

E. FERTILIZER

All fertilizer shall be checked and approved for acceptance prior to use. Fertilizer shall be a commercial turf product containing nitrogen, available phosphoric acid and soluble potash as required, in a recognized plant food form. All fertilizer shall comply with the provisions of the State of Nebraska Fertilizer Act of 1955, with subsequent revisions.

This act requires:

1. Each brand and grade of commercial fertilizers must be registered by the Nebraska Department of Agriculture and Inspection.
2. Each container of commercial fertilizer shall have either placed on or affixed to the container in written or printed form, the new weight and the following information:
 - a. The name and address of the person guaranteeing the fertilizer.
 - b. The guaranteed analysis showing the minimum percent of plant food claimed in the following form:

Total nitrogen (N)____%
% Cold Water Insoluble Nitrogen (CWIN) (if applicable) ____%
Available Phosphoric Acid (P₂O₅) ____%
Soluable Potash (K₂O)____%

If distributed in bulk, a written or printed statement of the weight and preceding information shall accompany delivery and be supplied to the City's Project Manager. Any grade or mixture of grades of phosphoric acid and potash fertilizer may be used providing the proportions of the minimum rate of application per acre are in conformance with these Standard Specifications or as directed by the City's Project Manager. Components of bulk blends must be close in particle size to prevent segregation. The City's Project Manager may approve immediate use of any commercial turf or fertilizer which is registered for sale in Nebraska.

F. TOPSOIL

Shall be fertile, friable, natural loam, dark in color (often black), free of subsoil, clay lumps, brush, weeds, roots, stumps, stones larger than 1-1/2" in any dimensions, debris and other extraneous or toxic matter and harmful to plant growth. Topsoil shall be obtained from local sources and exhibit an acidity range (pH) of 6.0 to 8.5. Identify location of source.

G. COMPOST

Shall be humus-like material made from the decomposition of organic materials which may have included leaves, branches, yard prunings and grass clippings such as LINGRO compost. The compost materials shall be decomposed to form a highly stabilized product and screened with 1/2" or less screen opening. The compost shall be free of all inorganic debris. LINGRO compost is available from the City of Lincoln's Solid Waste Operation. Ratio of topsoil to compost should be a minimum of 2 to 1.

30.04 MATERIALS (GENERAL INFORMATION) (Continued)

H. MULCH

Mulching shall be applied in such a manner as to remain in place. An alternative may be approved by the City's Project Manager. Mulch alternatives shall include the following:

1. Hydro-mulch: If hydro-mulch is used, it shall be evenly applied to all seeded areas at the minimum rate of 2,000 pounds per acre with a 3% tackifier and shall be applied immediately after seed application.
2. Peat moss: If peat moss is used, it shall be evenly applied to all seeded areas at the minimum rate of 1 cubic yard per 1,000 square feet. The peat moss will be pulverized, will not be less than 60% decomposed organic matter by weight, and will have a pH from 4 to 6.
3. Prairie Hay: If hay shall be used, it shall be applied evenly over the seeded surface at the minimum rate of 2 tons per acre. Hay shall be obtained from local source.
4. Wheat Straw: If wheat straw shall be used, it shall be applied at the rate of 3 tons per acre.
5. All materials used as mulch will be free from all noxious weed, seed-bearing stalks, or roots and shall be inspected and approved the City's Project Manager.

I. WATER

1. Water shall be potable.
2. The Contractor shall provide water, equipment, methods of transportation, water tanker, hoses, sprinklers, and labor necessary for the application of water.

30.05 GENERAL CONSTRUCTION METHOD

A. GENERAL

Examine finish surfaces, grades, topsoil quality and depth. Do not start seeding, sodding or plugging Work until unsatisfactory conditions are corrected.

B. PREPARATION OF SOIL

1. Apply Roundup or approved equal non-selective post-emergent herbicide to all areas to be seeded, sodded or plugged prior to preparation. Apply per manufacturer's instructions.
2. Existing weed stubble and small weeds shall be cut and partially incorporated into the soil during seed bed preparation Work. All other vegetation that will interfere with the seeding or sodding operations shall be removed by the Contractor. Extreme care shall be exercised to avoid injury to trees and shrubs.
3. Limit preparation to areas which will be immediately seeded, sodded or plugged. Remove stones over 1" in any dimension and sticks, roots, rubbish and extraneous matter.
4. The seed bed shall be prepared not more than 3 days prior to the installation of seed, plugs, or sod by loosening the soil to a depth of not less than 2" nor more than 4" by disking, harrowing or tilling. Surface crusting caused by water during the interim must be loosened prior to the seeding operation. All soil erosion shall be filled prior to the seeding or plugging operation.

30.05 GENERAL CONSTRUCTION METHOD (Continued)

B. PREPARATION OF SOIL (Continued)

5. Top soil shall be of a quality to support the growth of grass. The area shall be in a smooth even condition, free of all debris, roots and stones larger than 1" in their largest dimension. All lumps of soil shall be pulverized, raked out or removed. Areas not suitable to support the growth of vegetation must be amended by adding compost and/or other organic matter.
6. Grade lawn areas to a smooth, free draining and even surface with a loose, moderately course texture. Roll and rake, remove ridges, and fill depressions as required to drain. Surface crusting caused by water during the interim between preparation and seeding, sodding or plugging must be loosened prior to installation.
7. The seed bed adjacent to curbs, walks or other paved areas shall be finished to a grade of 1" below the paved surface in the case of seeding or plugging and 1" below for sodding.
8. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to seeding, sodding or plugging.

C. FERTILIZING

The fertilizer shall be applied with approved mechanical spreaders or with an approved hydraulic seeder at the rates specified in these provisions and shall cover the entire area uniformly. Any fertilizer blending shall be approved by the City's Project Manager.

On the basis of the guaranteed analysis, the City's Project Manager shall specify the mixing proportions (if necessary) and application rate necessary to provide the correct (N-P-K) nutrients in conformance with the plans or Special Provisions.

Fertilizers containing quick release sources of nitrogen can be used in the spring and fall when temperatures are not to exceed 80 degrees F. Caution must be taken in application to ensure the rate does not exceed one pound of nitrogen (N) per 1,000 square feet. Quick release fertilizers must be applied to dry foliage only to prevent phytotoxicity. The fertilizer source exhibiting the lowest salt index should be chosen to further prevent phytotoxicity.

Starter type fertilizer shall be incorporated into the soil prior to plugging, seeding or sodding. Maintenance fertilizer shall be applied after laying the sod. The application rates for fertilizer shall conform to Chapter 30 of the Standard Specifications.

D. SITE CLEAN-UP

Any remaining peat, soil, sand, rock or similar material which has been brought onto the site by Work operations or otherwise, will be removed, and all other remaining debris will be disposed of. All ground area disturbed as a result of the sodding operations will be renovated to its original condition or to the required new condition.

30.06 COVER CROP

A. GENERAL

A cover crop may serve as an alternative to providing soil cover when seeding, sodding or plugging is not an alternative. Cover crop is intended to prevent soil erosion by wind and water. Cover crops may be used in situations in the following situations:

1. The window for seeding, sodding or plugging has passed.
2. If a quick cover is necessary to prevent erosion prior to the completion of the project.
3. To be planted in conjunction with seed or plugs to provide quicker immediate coverage until the desired specified material is established.

The following cover crops may also be used as mixes requiring adjustments made to the seeding rates.

B. EARLY SEASON (SPRING COVER CROP)

A spring cover crop is planted in early spring to provide soil cover during the spring. Alternatives include:

<u>Type of Seed</u>	<u>Application Rate Lb/acre</u>
Annual Rye	20 - 25
Winter Rye	20 - 25
Alfalfa (Ranger or Vernal)	18
Seeding Period:	March 1 - May 20
General Application:	1 to 1.5 bu/acre

Spring cover crops can be established by aerial seeding in the spring, as well as by drilling or broadcasting seed.

C. MID-SEASON (LATE SUMMER/FALL COVER CROP)

A mid-season cover crop is planted in late spring or early summer to provide soil cover during the late summer and fall. Alternatives include:

<u>Type of Seed</u>	<u>Application Rate Lb/acre</u>
Annual Rye	20 - 25
Alfalfa (Ranger or Vernal)	18
Seeding Period:	May 21 - July 20
General Application:	1 to 1.5 bu/acre

Mid-Season cover crops can be established by aerial seeding in the late spring to summer, as well as by drilling or broadcasting seed.

30.06 COVER CROP (Continued)

D. LATE SEASON (WINTER COVER CROP)

A winter cover crop is planted in late summer or fall to provide soil cover during the winter. Plants selected need to possess enough cold tolerance to survive hard winters. Alternatives include:

<u>Type of Seed</u>	<u>Application Rate Lb/acre</u>
Winter Rye	20 - 25
Alfalfa (Ranger or Vernal)	18
Seeding Period:	Aug. 1 – Sept. 30
General Application:	1 to 1.5 bu/acre

NOTE: After August 31, Hairy Vetch may be used at the rate of 25 pounds per acre.

Winter cover crops can be established by aerial seeding in the late summer or fall, as well as by drilling or broadcasting seed.

30.07 SEEDING

The seeding operation shall be restricted to the periods listed under the seeding mixtures (31.05) unless otherwise authorized by the City's Project Manager. No Work shall be accomplished when the ground is frozen, or otherwise untillable.

Appropriate mechanical spreaders approved the City's Project Manager. Hydraulic seeding equipment also may be used when approved by the City's Project Manager. All equipment used for the seeding operation shall be as per the manufacturer's recommendations.

A. GENERAL

The Contractor will provide all labor, equipment and materials necessary to furnish and install seed as required by the accepted plans and these Standard Specifications.

B. TOPSOIL

Topsoil preparation will be as described in this Section, Topsoil Preparation, of these Standard Specifications.

C. BOOSTER FERTILIZER

All fertilizer requirements will meet the requirements of this Section, Topsoil Preparation, of these Standard Specifications. A booster fertilizer with the chemical analysis of Nitrogen-18, Phosphorous-46, Potash-0, with 4% iron and 8% sulfur will be applied on the prepared soil at the rate of 5 pounds per 1,000 square feet immediately prior to seeding.

D. SEED

Seed will be furnished in sealed, unopened, standard containers and labeled in conformance with the USDA Rules and Regulations and the Federal Seed Act. Seed will be fresh, clean, pure live seed equal in quality to the standards for Certified Blue Tag Seed. The City's Project Manager, at the Contractor's expense, may require tests of seed verification.

30.07 SEEDING (Continued)

E. MULCHING

Mulching shall be applied loose enough to allow sunlight to penetrate and air to circulate slowly, but thick enough to partially shade the ground, reduce water evaporation and reduce wind and water erosion. Mulching also shall be applied in such a manner as to remain in place as per these Standard Specifications.

F. SEEDING METHOD

1. Fescue/Bluegrass Seeding

- a. Whenever possible, the seed will be applied using a Brillion seeder or equal equipment to drill the seed into a properly prepared seedbed. The seeder will be equipped with a satisfactory feeding mechanism, an agitator, double disc furrow openers, depth bands and packer wheels. Seed will be sown to a depth of 1/4" into a properly prepared seedbed. Seed drilling will be done in 2 separate applications crossing the area at right angles to one another to guarantee proper coverage. On sloping land, the final seeding operation will follow the general contour. All seeded areas will be top-dressed with either hydro-mulch or peat moss after the seeding is completed.
- b. In areas where the drill method of seeding cannot be used, a broadcast method may be substituted. If the broadcast method is used, the seeding rate must be doubled, and the area must be dragged after seeding followed by a suitable top dressing.
- c. Immediately following the completion of the seeding operation, the entire area shall be compacted with an approved roller.

2. Hydraulic Seeding

- a. Hydraulic seeding shall be the process by which, initially grass seed is combined with a water solution and applied to a prepared seed bed by means of a hydraulic sprayer. The material shall be a natural or cooked cellulose fiber processed from whole wood chips which will disperse readily in water, mulch, non-toxic dye and other approved additives are combined with a water solution and applied in the same manner. The mulch fibers will physically form a strong moisture-holding mat to assist in soil erosion control, while providing percolation properties and favorable micro climate conditions.
- b. Hydraulic seeding equipment shall include a pump, rated and operated at 100 gallons per minute (375 L/min) and at 100 psi (690 kPa) pressure, unless otherwise directed by the City's Project Manager. The equipment shall have a suitable pressure gauge, and a nozzle adapted to the type of Work. Storage tanks shall have a means of estimating the volume used or remaining in the tank. When using hydraulic seeding, the seed bed preparation, fertilize, and watering instructions shall be in conformance with the requirements of this chapter as stated for "Seeding".

All equipment and materials shall be approved by the City's Project Manager prior to the seeding operation.

30.07 SEEDING (Continued)

F. SEEDING METHOD (Continued)

3. NATIVE SEEDING

- a. Whenever possible, the seed will be applied using a drill-type seeder. Seed will be sown to a depth of 1/2" into a properly prepared seedbed. On sloping land, the seed shall be applied following the general contour. All seeded areas will be top dressed with either hydro-mulch, peat moss, or straw after the seeding is completed.
- b. In areas where the drill method of seeding cannot be used, a broadcast method may be substituted. When using the broadcast method, the seeding rate must be doubled, and the area must be scarified and dragged after seeding, followed by a suitable top dressing.

G. ADDITIONAL FERTILIZING

At the time of the first mowing, the Contractor will apply a commercial fertilizer with the chemical analysis of Nitrogen-20, Phosphorous-10, Potash-5, plus 2% iron at the rate of 5 pounds per 1,000 square feet. Care should be taken to prevent burning. Any areas disturbed or damaged by the Contractor during fertilizing operations will be repaired in conformance with these Standard Specifications at the Contractor's expense.

H. WATERING

The Contractor will be responsible for watering the seeded area(s) a minimum of 2 times per day (mid-morning and late afternoon) and for keeping the areas moist until the lawn is established. The Contractor will be responsible for water usage until the vegetation is accepted.

I. INSPECTIONS

Inspections shall be completed in conformance with this Section, Inspections, of these Standard Specifications. The Contractor must notify the City's Project Manager for inspections of seed certification and germination.

J. GERMINATION INSPECTIONS

When germination is complete and plants are visible, the Contractor will notify the City's Project Manager and request a germination inspection for approval in order to begin the guarantee period. Any areas deemed by the City's Project Manager to be thin, weak or dead will be replaced at this time. All washouts will be reseeded immediately after the germination inspection. No partial acceptance will be made. The Contractor shall be responsible for the growth of the seeded area. Any portion of the seeded area that is not in good growing condition at the end of 30 days shall be re-seeded as specified for "Seeding" above.

30.07 SEEDING (Continued)

K. BASIS OF PAYMENT

The Contractor shall seed all areas disturbed by construction operations. Limits of the seeding areas to be used in determining payment quantities are indicated in the plans. Areas outside those limits shall be seeded at the Contractor's expense. No separate measurement or payment shall be made for soil preparation. This Work shall be considered subsidiary to seeding for which direct payment is made.

Seeding of the various types called for on the plans, completed in conformance with the plans and Standard Specifications and acceptable to the City's Project Manager shall be measured to the nearest 0.1 or the nearest square foot and paid for at the contract unit price bid per acre or per square foot for SEEDING, TYPE _____. Such payment shall be full compensation for all labor, equipment, tools, materials, fertilizer, water establishment period and incidentals necessary to complete the Work.

30.08 SODDING

A. GENERAL

Sod shall not be placed on frozen ground or during drought periods. The sod shall be moist when it is placed. Dry and/or frozen sod will not be accepted. Transverse joints between sod strips shall be staggered. The sod shall be placed carefully to produce tight joints. The sod shall be watered immediately after it is placed. Firming shall be accomplished by rolling the newly placed sod with an approved sod roller within 7 days after it is replaced.

The Contractor will provide all labor, equipment and materials necessary to furnish and The Contractor will provide all labor, equipment and materials necessary to furnish and install all sod as required by the accepted plans and these Standard Specifications.

B. TOPSOIL

Topsoil preparation will be as described in this Section, Topsoil Preparation, of these Standard Specifications.

C. BOOSTER FERTILIZER

All fertilizer will meet the requirements of Chapter 30 of these Standard Specifications. A booster fertilizer with a chemical analysis of Nitrogen-12, Phosphorous-12, Potash-4, with 4% iron and 8% sulfur will be applied at a rate of 5 pounds per 1,000 square feet immediately prior to sodding.

D. CARE AND HANDLING

Care will be exercised at all times to retain the native soil on the sod roots during transportation, handling and planting. Dumping sod from vehicles will not be permitted. The sod will be transported to the site within 24 hours from the time it is cut, unless it can be stored to the satisfaction of the City's Project Manager. During delivery and while in stacks, all sod will be kept moist and protected from exposure to the wind, sun and freezing. All damaged or dry sod will be rejected.

30.08 SODDING (Continued)

E. TRANSPORTING SOD ON SITE

Sod can be transported on or across the site on pallets by forklift. Damage to the sod bed by the vehicles will be kept to a minimum and will be regraded before sodding of the area. Damage caused to paving, curbs, fence, plants or other objects during sodding, will be repaired or replaced by the Contractor at his expense as directed by the City's Project Manager.

F. INSTALLATION

The sod bed will be lightly sprinkled just prior to laying the sod. All sod strips will be placed tightly against each other so no open joints are apparent. Joints between ends of strips will be staggered at least 1' between adjacent rows. At the end of walks and drives, the sod will have the same finish grade as the abutting surfaces. At curbs the sod will have the same finish grade as the top of the curb. Sod placed on slopes equal to 4:1 will be staked with wood or wire pins not less than 6" long and spaced not more than 30" apart. The pins shall be driven into the ground at an angle against the flow of the water until the top of the stake is 3" above the sod. Sod laying will begin at the bottom of the slope and progress upward with strips laid transverse to the slopes. Immediately after the sod has been laid, it should be tamped or rolled with approved equipment to eliminate all air pockets and to provide a smooth, even surface. Immediately after rolling or tamping the sod, sufficient water will be applied to completely saturate the sod. The sod will be watered as often as required to prevent it from drying out. Settled sod areas will be pulled up, regraded, relayed, and retamped.

G. MAINTENANCE

The proper care and maintenance of the sodded areas will be the responsibility of the Contractor until the Work has been completed and accepted by City's Project Manager. The maintenance operations will begin as soon as each portion of the area is sodded. Maintenance will consist of repair and replacement of eroded areas, watering, mowing (when the sod is established), weeding, fertilizing, and resodding as necessary to provide an even, consistent stand of grass. All replacement sodding deemed necessary will be done by the Contractor at his own expense.

H. MOWING

During the maintenance period, after the sod is established, the Contractor will begin mowing all lawn areas on a routine basis using a mowing height of 3". Frequency of mowing will be determined by the growth rate of the grass but at no time should the clippings exceed 2" in length. Only turf-type mowers will be used for this operation.

I. ADDITIONAL FERTILIZING

30 days after sod is laid, an application of fertilizer with the chemical analysis of Nitrogen-12, Phosphorous-12, Potash-4, with 4% iron and 8% sulfur will be applied at the rate of 6 pounds per 1,000 square feet. When applied, the fertilizer must be dry and free flowing. All damage caused to the sod during fertilizer application will be repaired by the Contractor at his expense.

J. WATERING

The Contractor will be responsible for watering the sodded area(s) a minimum of 2 times per day (mid-morning and late afternoon) and for keeping the areas moist for a period of 14 days following the initial sodding operation and until the sod is established.

30.08 SODDING (Continued)

K. INSPECTIONS

Inspections shall be completed in conformance with this Section, Inspections, of these Standard Specifications. The Contractor must notify the City's Project Manager for inspection of sodding. When sodding operations are complete, the Contractor will notify the City's Project Manager and request a sodding inspection for approval in order to begin the guarantee period. Any areas deemed by the City's Project Manager to be thin, weak or dead will be replaced at this time. No partial acceptance will be made. Any portion of the sodded area that is not in good growing condition will be moved and replaced with fresh live sod. If the sod has been replaced the water period will begin again for 14 days following the replacement.

L. BASIS OF PAYMENT

The Contractor shall sod all areas disturbed by construction operations. Limits of the sodding areas to be used in determining payment quantities are indicated in the plans. Areas outside those limits shall be sodded at the Contractor's expense. No separate measurement or payment shall be made for soil preparation. This Work shall be considered subsidiary to sodding for which direct payment is made.

Sodding completed in conformance with the plans and Standard Specifications and accepted will be paid at the contract unit price bid per square foot for SODDING. Such payment shall be full compensation for all labor, equipment, tools, materials, incidentals necessary to complete the Work.

30.09 PLUGGING

A. GENERAL

The Contractor will provide all labor, equipment and materials necessary to furnish and install all sod plugs as required by the accepted plans and these Standard Specifications.

B. TOPSOIL

Topsoil preparation will be as described in this Section, Topsoil Preparation, of these Standard Specifications.

C. SOD PLUGS

The Contractor shall obtain sod plugs from strongly rooted, nursery grown sod composed of grass species referred to in Chapter 30 of these Standard Specifications. Provide healthy living stems with attached roots. Provide 1" x 1" plugs. Plugs shall be uniform in color and quality and shall be free of weeds, disease or visible imperfections at the time of acceptance.

D. OVERSEEDING WITH COVER CROP (ALTERNATIVE)

To expedite coverage of an area, annual rye may be used as a cover crop in conjunction with the sod plugs. The overseeding of annual rye shall be between 1 and 2 pounds per 1000 sq. ft. This will provide quick coverage and still allow for the establishment of the plugs. Overseeding may result in clean-up of spent crop by mowing.

30.09 PLUGGING (Continued)

E. BOOSTER FERTILIZER

1. Fertilizer shall be a commercial turf product containing nitrogen, available phosphoric acid (P205) and soluble potash (K20) as required, in recognized plant food form. All fertilizers shall comply with the provisions of the State of Nebraska Fertilizer Act of 1955, with subsequent revisions.
2. Granular, non-burning product of neutral character composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer. Starter fertilizer containing 10% nitrogen, 20% phosphoric acid, and 10% potash by weight, or similar approved composition. Fertilizer shall not contain any herbicide or weed killers.

F. PRE-EMERGENT CONTROL

Plateau Herbicide manufactured by American Cyanamid Company, or approved equal.

G. POST-EMERGENT CONTROL

Round-up Herbicide, manufactured by Monsanto, or approved equal. Do not apply product containing 2, 4-D if temperatures are expected to exceed 80 degrees F on the day of application.

Dormant buffalo grass can be sprayed with Roundup or equivalent to control winter weeds. Fall applications can be applied after the first frost or when the buffalo grass turns straw-brown.

Spring Application of Roundup or equivalent can be done in early April. A period of two weeks should be allowed for the herbicide to work. Roundup or equivalent should not be applied to buffalo grass if the dormant turf is showing any green color. Roundup or equivalent applied to semi-dormant buffalo grass will significantly delay green up and could severely damage the grass.

H. CARE AND HANDLING

1. Care will be exercised at all times to retain the native soil on the sod roots during transportation, handling and planting. Dumping sod plugs from vehicles will not be permitted. The sod plugs will be transported to the site within 24 hours from the time harvested, unless it can be stored to the satisfaction of the City's Project Manager. All sod plugs will be kept moist and protected from the exposure to the wind, sun and freezing. All damaged or dry sod plugs will be rejected.
2. Do not harvest or transport sod plugs when moisture contact may adversely affect the sod's survival.
3. Protect sod plugs from sun, wind, and dehydration prior to installation.

30.09 PLUGGING (Continued)

I. INSTALLATION

1. Plugs shall not be placed during periods of drought.
2. Plant individual plugs with root cluster and portions of stem buried in soil. Firm the soil around plugs after planting. Do not cover tips.
3. Space plugs 12" on center each direction or as otherwise specified by the City's Project Manager.
4. Drill a hole 1 1/4" diameter and 1 1/4" deep. Place the plug into the hole, being sure the plug is to the bottom of the hole. Failure to place plug firmly to the bottom of hole will create an air pocket under the plug, reducing the change for survival. Measure the next plug, using the specified spacing. Repeat installation procedure. Continue in a straight line to the end of the planting area. Move the specified spacing for the second row and continue planting. Stagger plugs as in Figure 1.

X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X

Figure 1

5. Plant plugs and lightly roll with lawn roller
6. Water plugs with a fine spray immediately after planting.
7. If plugs are installed in an area with a 4:1 slope or greater, an erosion control blanket shall be laid over the entire plugged area. Secure erosion control blanket to ground with 6" wire staples, 6" wood or 6" plastic pins.
8. Plugged areas shall be watered twice daily for 10 minutes per setting during the first 14 days after planting. After 14 days, the plugged areas shall be watered once per day for 15 minutes per setting. After the fourth week, soak the area once or twice per week until plugs have covered the area. These guidelines are subject to variance with the City's Project Manager.
9. Apply Plateau herbicide, or approved equal pre-emergent control within 5 days after initial watering at a rate of 1 ounce per acre or recommended label rate.
10. Apply starter fertilizer to plugged areas at a rate equal of 1.0 pound of actual nitrogen per 1,000 square feet. Apply first application of fertilizer 3 weeks after initial plugging. Apply fertilizer by mechanical rotary or dry type distributor, thoroughly and evenly incorporated across the plugged areas. Apply second application of fertilizer 8 weeks after initial plugging.
11. A lightweight, biodegradable, erosion control blanket such as XCEL SR Straw blanket, XCEL S-2 Superior excelsior blanket, North American Green DS150 or equivalent may be used over the top of the plugs to preserve moisture or control erosion at the discretion of the City's Project Manager.

30.09 PLUGGING (Continued)

J. MAINTENANCE

1. Maintain plugged areas until completion and acceptance of the entire project. Maintain plugged areas including watering, weed control, mowing, application of herbicides, fungicides, insecticides, resodding until an established planting is achieved and accepted by the City's Project Manager.
2. A nitrogen fertilizer should be used every 30 days until fully established.
3. Keep all plugged areas thoroughly watered for 60 days after final acceptance of the entire project per the Standard Specifications. Any portion of the plugged area that is not in good growing condition at the end of the 60 days shall be re-plugged as specified above.
4. Begin mowing the plugged area as soon as the plugs attain a height of 3" and cannot be easily pulled out of the soil. Maintain all plugged areas at a height of 3" for 60 days after the final acceptance.
5. Repair, rework and replug all areas that have been washed out, eroded, or do not catch at the end of the 60 days.
6. The proper care and maintenance of the plugged areas will be the responsibility of the Contractor until the Work has been completed and accepted by the City's Project Manager.

K. INSPECTIONS

Inspections shall be completed in conformance to these Standard Specifications. The Contractor must notify the City's Project Manager for inspection of plugged areas. When operations are completed, the Contractor will notify the City's Project Manager and request an inspection for approval in order to begin the guarantee period. Any areas deemed by the City's Project Manager to be thin, weak or dead will be replaced at this time.

L. BASIS OF PAYMENT

The Contractor shall plug all areas disturbed by construction operations. Limits of the plugging areas to be used in determining payment quantities are indicated in the plans. Areas outside those limits shall be plugged at the Contractor's expense. No separate measurement or payment shall be made for soil preparation. This Work shall be considered subsidiary to plugging for which direct payment is made.

Plugging completed in conformance with the plans and Standard Specifications and acceptable to the City's Project Manager shall be measured and paid for at the contract unit price bid per square foot for PLUGGING. Such payment shall be full compensation for all labor, equipment, tools, materials, fertilizer, water establishment period and incidentals necessary to complete the Work.

30.10 ACCEPTANCE AND ESTABLISHMENT PERIOD

Upon completion of planting the City's Project Manager will inspect the seeded/sodded/plugged area(s) for acceptability. The Contractor will be notified of the dates of this inspection. All items of Work as required in the Standard Specifications, the Special Provisions, and the plans shall have been performed prior to this inspection. Any item not completed may make a planting unacceptable. Unacceptable materials may be allowed to remain in place without payment. An inspection may be made subsequent to the final inspection to determine the acceptability of material and therefore, allowing payment for such materials.

During the establishment period, the Contractor shall properly maintain all materials planted under the contract. The establishment procedures shall include, protective measures against pests and diseases, watering as often as required by necessity, seeding with a pre-emergent weed control or other approved means, and other establishment procedures as deemed necessary by the City's Project Manager including the removal of any dead plant material for the project. The Contractor shall be responsible for watering all plant material as necessary during the establishment period.

The establishment period will follow the completion of all planting and shall extend for a period of:

SEED	30 days
SOD	14 days
PLUGS	60 days

The establishment period will not begin until all of the following items of Work as required in the Standard Specifications, the Special Provisions, and the plans have been performed including proper installation of material, watering, fertilizing and mulching. All plant material shall be in viable growing condition when the project enters the establishment period.

Upon completion of the establishment period, the City's Project Manager will inspect the seeded/sodded/plugged material to identify any material to be replaced under warranty. The inspection will normally be made during the month that the establishment period terminates. The Contractor will be notified of the dates of this inspection. A list of quantities and locations will be provided to the Contractor for replacement. Replacement of materials shall occur within receipt of this list. Plant replacement shall be at the Contractor's expense. Establishment procedures that have not been performed shall be brought to the Contractor's attention and may cause the establishment period to be extended. All replacement plant material shall receive the establishment procedures referred to in this Section. The Contractor will be notified in writing when his/her establishment responsibilities on the acceptable material have been terminated.

30.11 REPLACEMENT OF MATERIAL AND GUARANTEE PERIOD

The guarantee period for seeded/sodded/plugged areas shall begin at the date of acceptance.

The Contractor shall guarantee all material to be in healthy and flourishing condition for a period of:

SEED	60 days
SOD	30 days
PLUGS	90 days

from date of acceptance.

The Contractor shall replace, without cost, and as soon as weather conditions permit and within a specific planting period, all materials determined by the City's Project Manager to be dead during or at the end of the guarantee period.

Replacement material shall closely match adjacent specimens of the same species that have been planted. Replacements shall be subject to all requirements, standards, special provisions and Standard Specifications stated herein.

The guarantee of all replacement plants shall extend for an additional period of:

SEED	60 days
SOD	30 days
PLUGS	90 days

from date of their acceptance and installation. In the event that replacement materials are not acceptable during or at the end of the said extended guarantee period, the City's Project Manager may elect subsequent replacement or credit (refund) for them.

30.12 VANDALISM

Seeded/Sodded/Plugged areas damaged to be replaced as a result of vandalism as a part of this contract shall be paid for by the City.

30.13 QUALIFICATIONS FOR SUBMITTING BIDS

- A. Contractor must be able to demonstrate a minimum work experience record.
- B. Contractor must be able to demonstrate successfully completed projects similar to scope and scale.

CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 31

LANDSCAPE WORK

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CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 31

LANDSCAPE WORK

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CHAPTER 31

LANDSCAPE WORK

31.00 DESCRIPTION

The Work described in this section shall pertain to any landscape work. Work shall include all labor, material and equipment as herein specified. The Work shall comply with the requirements of all legally constituted authorities having jurisdiction.

Nomenclature used in these Standard Specifications and the Special Provisions, and the plans shall conform to the standard nomenclature established in "Hortus Third"; American Standard for Nursery Stock (ANSI Z60.1-2004) or the Tree and Shrub Transplanting Manual, 1991 or current revision.

Plant material shall mean trees, shrubs, vines, ground covers and plants of all descriptions, required to be furnished for the project, in conformance with these Standard Specifications, the Special Provisions, and the details shown in the plans.

This Work shall consist of furnishing, delivering and planting of plant material and all operations incidental thereto, in conformance with Lincoln Standard Plans, any Special Provisions, and these Standard Specifications.

31.01 QUALITY ASSURANCE

All plant material shall conform to the American Standard for Nursery Stock (ANSI Z60.1-2004 or most current).

Trees, Shrubs and Plants: Provide healthy, vigorous stock, grown in recognized nursery in conformance with industry proven horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.

If specified landscape material is unobtainable, submit proof to City's Project Manager together with proposal for use of equivalent material.

The City's Project Manager may inspect trees, shrubs, and other plant material either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size and quality, size and condition of balls and root systems, insects, injuries and latent defects. The City's Project Manager may reject unsatisfactory or defective material at any time during progress of Work. Rejected plant material shall be immediately removed from project site.

Submittals shall include:

- Certificate of Inspection - certificates of inspection as required by governmental authorities.
- Certified Analysis - manufacturer's certified analysis, or, where applicable, analysis of recognized laboratory made in conformance with methods established by the Association of Official Agriculture Chemists, including soil amendments and fertilizer materials.
- Container-Grown Material - samples of all container-grown material prior to planting.
- List of Sources - a written list of the nurseries where the plant material was grown. Plant materials from unapproved sources will be rejected.

31.02 PLANTING SEASON

Within thirty days after receiving the signed contract, the Contractor shall submit a written list of the nurseries from whom the Contractor will purchase the plant material, and the source where the plant material was grown. The list shall be submitted to the City's Project Manager. The Contractor will be notified if there are any unapproved sources of plant materials on the list. Plant materials from unapproved sources will be considered for rejection.

The planting season for all plant material shall be: Fall Planting season shall be from September 15 to December 1 for all coniferous materials, from September 15 to December 1 for all deciduous materials and August 15 to September 15 for all perennials and ornamental grasses; Spring Planting season shall be from March 1 to June 1 for all coniferous materials, from March 1 to June 1 for all deciduous materials and May 1 to June 1 for all perennials and ornamental grasses. Planting operations shall be performed during this season only, except when prior written permission is obtained from the City's Project Manager. The actual planting shall be performed during those times in this season which are normal for such Work as determined by weather conditions, and accepted practice in the locality.

31.03 MATERIALS

A. GENERAL PLANT MATERIALS REQUIREMENT

1. All plant material shall conform to the American Standard for Nursery Stock (ANSI Z60.1 2004 or most current)
2. All plant material shall comply with all applicable State and Federal laws, including inspection certifications which shall include the project number and the plant material that the certification covers. All plant material is subject to inspection by representatives of the City, State and Federal Governments.
3. All plant material furnished shall be true to name and type and legible labels shall be furnished to ensure that all species, varieties, boxes, bundles, bales or other containers are identified. The information on the label shall cover the botanical genus, species, and common name, size or age of each species or variety.
4. All plant material shall be sound, healthy specimens and first-class representatives of their species or variety, and shall have well formed tops and healthy root systems.
5. Plant materials which lack proper proportions, or have serious injuries to the bark or roots, broken branches, objectionable disfigurements, shriveled dry roots, broken balls, insect pests, diseases, or which are not found to comply with these Standard Specifications in any way shall be rejected. Rejected plant material shall be removed from the project as soon as practical.
6. Plant materials which are planted and later discovered to be not true to name, may be allowed to remain in place without payment being made therefore.
7. A representative sample of all container grown and/or pot grown material shall be submitted to the City's Project Manager for approval prior to planting if requested.

31.03 MATERIALS (Continued)

A. GENERAL PLANT MATERIALS REQUIREMENT (Continued)

8. All balled and burlapped (B & B) and container grown plant material is subject to internal examination of the ball at any time to ascertain the condition of the roots and surrounding soil ball and the location of the root collar/trunk flare(s) in relation to the top of the soil ball. (See American Standard for Nursery Stock - ANZI Z 60.1 - 2004 or most current; Standard 1.6.3. Root ball depth)
9. Any plant material that is planted which does not meet the specified minimum size prior to pruning shall be rejected or allowed to remain in place without payment being made therefor.
10. If a Contractor is unable to locate sufficient plant material in specified sizes, negotiation for unit price reduction shall be concluded prior to planting.
11. All plant materials shall be of normal growth and uniform height, according to species, with straight established trunks and developed leaders, roots, and crowns. Heeled in stock will not be acceptable. Plants cut from larger sizes to meet bid Specifications shall not be accepted.
12. All plant material shall be true to species and variety specified and nursery grown in conformance with good horticultural practices. Plant material collected from wild or native stands will not be accepted, nor that which is sheared.
13. Coniferous trees (i.e., pines, firs, spruce) which have been sheared will not be accepted. All coniferous trees shall have a single leader with a viable bud. Trees with multiple leaders may be pruned leaving a single leader, providing that the resulting form is characteristic of the species.
14. All plant material shall be sound, healthy, vigorous, well branched and densely foliated if in leaf, free of disease, insects, eggs or larvae and shall have healthy, well developed root systems. They shall be free from physical or mechanical damage or conditions that would prevent thriving growth.
15. The bark of woody plant material shall be healthy and firm with no indications of fungus, cankers or galls, insect bores, die back, frost cracks, sun scald or mechanical injury. Any of these defects shall be reason for rejection.
16. All plant material shall exhibit adequate and healthy twig growth and have well formed live buds. Branches shall diverge from the trunk at a wide angle, except in those varieties that normally grow in narrow upright forms. Plants shall have normal, well developed branches, be uniformly and fully branched as seen from all sides, have good crotch angles and a vigorous root system. All plants shall be first class representatives of their species or variety.
17. Trees with multiple leaders, unless specified, shall be rejected.
18. Plants that meet specified sizes, but do not possess a normal balance between height and spread shall be rejected.
19. Plant material with a damaged or crooked leader or having pruning cuts over 3/4" in diameter that are not completely callused, shall be rejected.

31.03 MATERIALS (Continued)

A. GENERAL PLANT MATERIALS REQUIREMENT (Continued)

20. All plant material is subject to visual inspection by the City's Project Manager prior to installation. All plant material shall be assembled in one location to permit inspection if requested. The supplier of plant materials shall notify the City's Project Manager at least 5 working days prior to delivery so that a mutually agreeable time can be arranged for inspection, if requested by the City.
21. Substitution of specified plant material shall not be permitted unless authorized by the City's Project Manager.
22. Plants shall conform to the measurements specified, except that plants larger than those specified may be used if approved by the City's Project Manager. Use of larger plants shall not be cause for claims for additional payment. If larger plants are approved, the root system, container and/or root ball shall be increased in proportion to the size of plant.
23. Caliper measurements shall be taken on the trunk 6" above the natural ground line for trees up to 4" in caliper and 12" above the natural ground line for trees over 4" in caliper. Height and spread dimensions specified refer to the main body of the plant and not from branch tip to branch tip. Plants shall be measured when branches are in their normal position.
24. If a range of size is given, no plants shall be less than the minimum size and no less than 50% of the plants shall be as large as the maximum specified. Measurements specified are minimum size acceptable after pruning, where pruning is required. Plants that meet height and spread but do not possess a normal balance between height and spread shall be rejected.
25. Plant material Specifications for street trees will establish the height to which trees should be free of branching. Height of branching should bear a relationship to the size and kind of tree so that the crown of the tree will be in good balance with the trunk (i.e. $\frac{1}{2}$ to $\frac{1}{2}$ the total height of the tree is a trunk free of branching and the other $\frac{1}{2}$ to $\frac{1}{2}$ is a well branched tree crown). Refer to Section 1, ANSI Z60-2004 or most current. Branching height for specified plant materials will be noted on the bid proposal and all bidders should be aware of this Standard Specification. Plant material not meeting this Standard Specification may be rejected by the City's Project Manager.
26. The minimum height growth for pine trees shall be as follows: a) trees 3' – 5' in height shall have at least 2' of new height growth during the last 2 growing seasons, and b) trees 5' and over in height must have at least 3' of new height growth during the last 3 growing seasons.

31.03 MATERIALS (Continued)

B. NURSERY GROWN PLANT MATERIALS

1. All plant materials shall be “nursery grown” by established commercial nurseries and sold to and installed by licensed and certified nurseries and/or landscape Contractors.
2. Fresh dug material is given preference over plant material held in storage. Plant material held in storage may be rejected if excessive growth has occurred in storage.
3. Unnecessary injury to or removal of fibrous roots from the plant material is cause for rejection of the plant materials. The soil for balled material shall be in such condition so as to insure no crumbling or cracking. Balls shall be wrapped with burlap prior to removal from the ground. The burlap shall be held in place with cord and pinning nails. Handling of balled and burlapped material shall be in such a manner as to keep the soil intact. Plant material on which earthen balls do not hold together or which crack in handling shall be rejected.
4. Balled plant material shall have a solid ball of soil of adequate size held in place securely and wrapped with burlap and tightly bound with twine or rope. Soil balls may also be secured with wire baskets.
5. Bare root plant material shall have abundant root growth and fibrous feeder roots with good color and moisture. Kinked, circling and/or girdling roots are not acceptable and plant material having such root systems shall be rejected.
6. Container grown plant material shall be well established in their containers. Container plant material which shows evidence of being root bound, overgrown, recently canned or which has girdling roots shall be rejected.
7. A processed balled shade or flowering tree (i.e., a tree dug bare root, while dormant, to which a growing medium is added around the roots to form a ball) shall not be acceptable.

C. SELECT TOPSOIL

Select topsoil shall be fertile, friable, natural loam, dark in color (often black), free of subsoil, clay lumps, brush, weeds, roots, stumps, stones larger than 1-1/2" in any dimensions, debris and other extraneous or toxic matter and harmful to plant growth. Topsoil shall be obtained from local sources and exhibit an acidity range (pH) of 6.0 to 8.5. Source locations shall be identified.

Select topsoil called for on the plans, completed in conformance with the plans and Standard Specifications, and acceptable to the City's Project Manager shall be measured and paid for at the contract unit price bid per cubic yard for SELECT TOPSOIL. Such payment shall be full compensation for all labor, equipment, tools, materials, and incidentals necessary to complete the Work.

31.03 MATERIALS (Continued)

D. COMPOST

Shall be humus-like material made from the decomposition of organic materials which may have included leaves, branches, yard prunings and grass clippings such as LINGRO compost. The compost materials shall be decomposed to form a highly stabilized product and screened with 1/2" or less screen opening. The compost shall be free of all inorganic debris. LINGRO compost is available from the City of Lincoln's Solid Waste Operation. Ratio of topsoil to compost should be a minimum of 2 to 1.

E. MULCH

Mulch for Trees, Shrubs and Perennials: Organic mulch, free from wood chips, sawdust and deleterious materials, suitable for top dressing of trees. Mulch shall consist of shredded native hardwood bark mulch not larger than 4" in length and 1/2" in width.

F. ANTI-DESICCANT

Anti-Desiccant: Emulsion type, film-forming agents designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in conformance with manufacturer's instructions.

G. PLANT STARTER

Plant Starter: Liquid solution with an analysis of 3-10-3 (low analysis fertilizer), such as Upstart manufactured by Ortho.

H. STAKES

Stakes shall be 2" x 2" square or 2" diameter round wooden stake of suitable length to adequately support the plant material. Typically, stakes will be a minimum of 6' in length. Stakes shall be driven at least 12" into the soil for secure support outside of planting ball. (Refer to details in Chapter 31.)

I. SUPPORT TIES

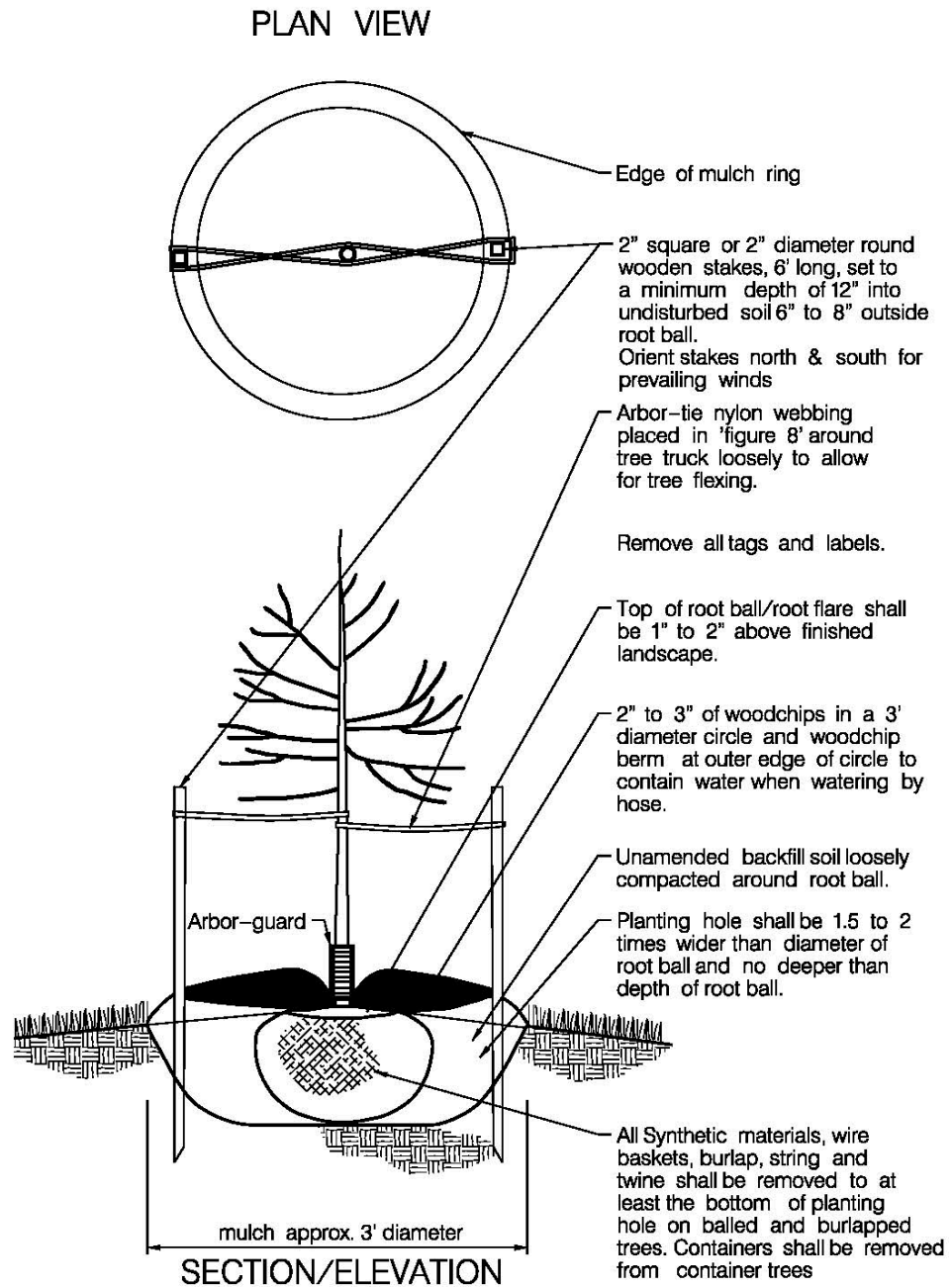
No metal wire or rubber hose shall be used in supporting trees. Trees should be secured to stakes using a fabric type of tree tie (i.e. Arbor Tie) or rubber cinch tie. The support shall be tied in a figure 8 loop between the tree and the stake(s) to allow for flexibility. Do not tie trees too rigidly to stakes. (Refer to details in Chapter 31.)

J. TREE WRAP

Tree wrap shall not be used on any trees planted in association with this contract. All existing tree wrap, cardboard or Styrofoam, if any, shall be removed from trunks immediately after planting.

K. TREE GUARD

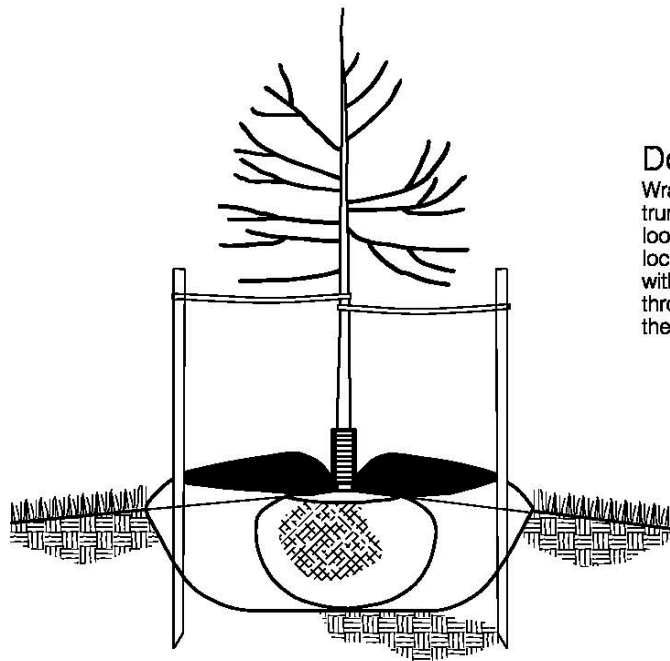
Tree guard (i.e. arbor-guard) shall be installed at the base of the trunk when the tree has been planted and will be provided by the City.



1 DECIDUOUS TREE PLANTING DETAIL FOR STREET & PARK TREES

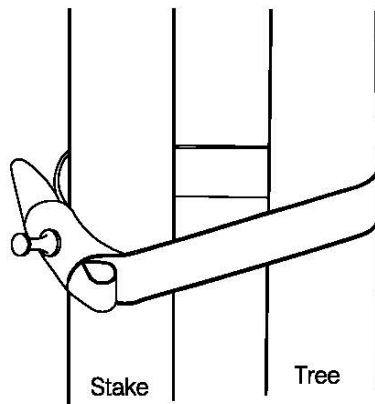
Not to Scale

Approved by the City of Lincoln Parks & Recreation Dept. 10/31/2019



Double Stakes

Wrap Cinch-Tie around the tree trunk and the stake to form a loop. Tie with the double-back locking configuration. Secure with a galvanized nail driven through the Cinch-Tie and into the stake to prevent slippage.



Standard Tie

Wrap Cinch-Tie around the tree trunk and the stake to form a loop. Tie with the double-back locking configuration. Secure with a galvanized nail driven through the Cinch-Tie and into the stake to prevent slippage.

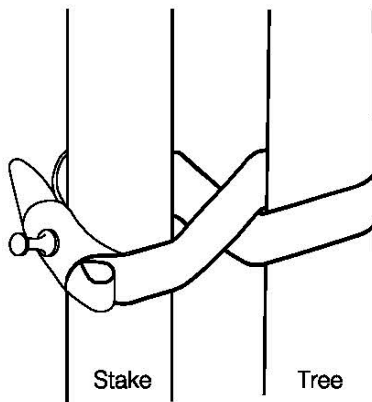


Figure Eight Tie

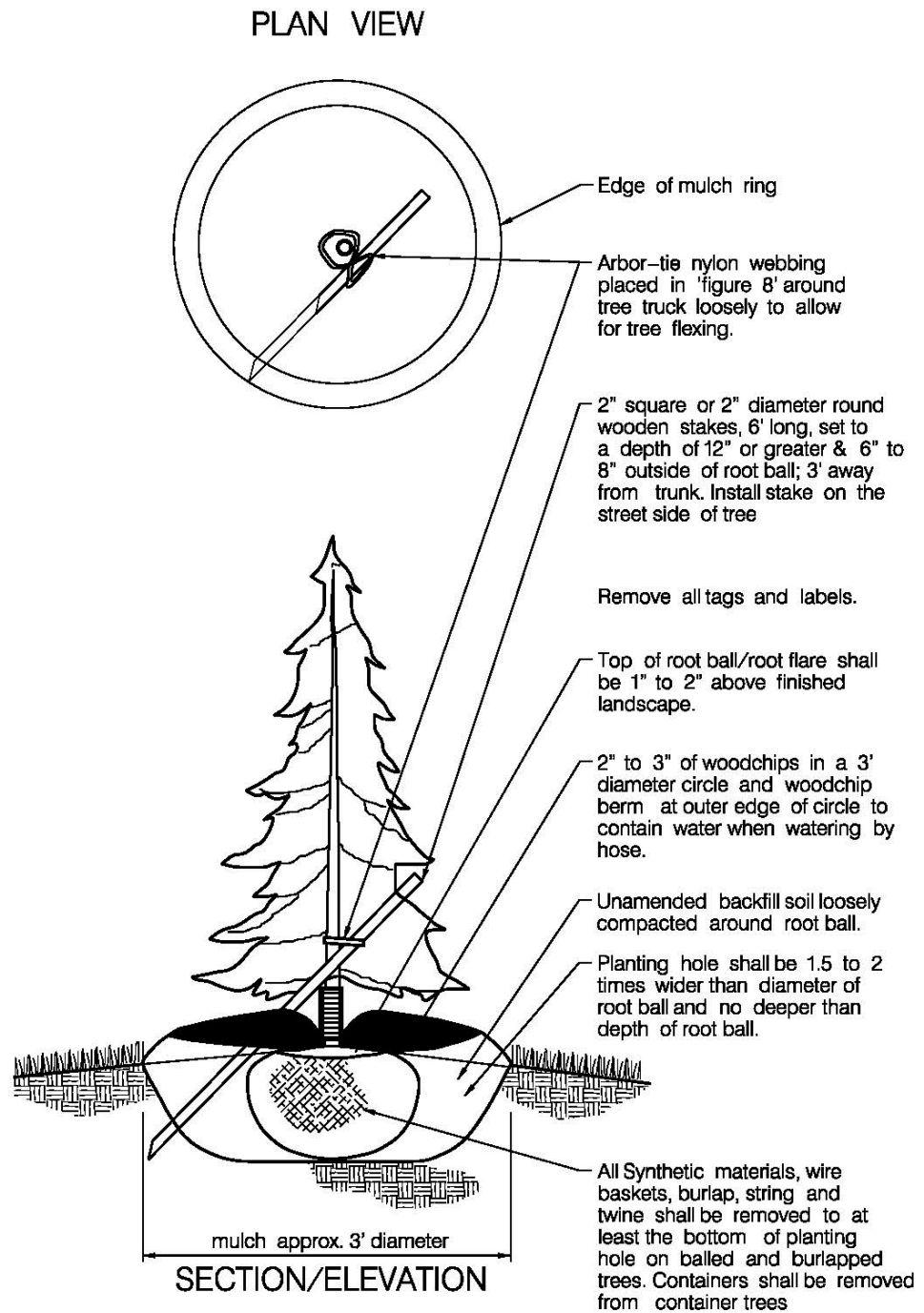
Wrap Cinch-Tie around the tree trunk and the stake twisting to form a figure eight. Tie with the double-back locking configuration. Secure with a galvanized nail driven through the Cinch-Tie and into the stake to prevent slippage.

2

CINCH-TIE DETAILS

Not to Scale

Approved by the City of Lincoln Parks & Recreation Dept. 10/31/2019



3

EVERGREEN TREE PLANTING DETAIL

Not to Scale

Approved by the City of Lincoln Parks & Recreation Dept. 10/31/2019

31.04 RECEIVING AND STORING OF PLANT MATERIALS

Storage facilities for plant material must receive approval of the City's Project Manager prior to delivery of the plant material. The storage facility shall have an adequate water supply, shade, good ventilation, and protection from drying winds.

Plant material that cannot be planted immediately on delivery shall be kept in storage, and well protected with wet soil, sawdust, wood chips, shingle tow, moss, peat, straw, hay or other acceptable moisture holding media. Plant material stored in the above manner shall be kept well watered.

31.05 TRANSPORTING PLANTS TO THE PLANTING SITE

Delivery and/or the planting of street trees shall be coordinated with the City's Project Manager at (402) 441-7847 at least 24 hours before planting or delivery. The successful bidder(s) shall notify the City's Project Manager as soon as possible when specified plant materials have been received so coordination of deliveries and/or plantings can be made. Plants shall be subject to inspection for conformity to Standard Specification requirements and approval by the City's Project Manager upon delivery and/or at time of planting, unless a request has been made for inspection prior to delivery.

1. LOADING

Care shall be taken to protect the trunk, branches and roots from abrasions and breakage when loading, transporting, unloading and/or planting. Plants too tall to be transported in an upright position must be tipped to a horizontal position. Branches must be tied prior to tipping to prevent breaking branches and bruising of the bark. The trunk and top must be supported when plants are tilted to a horizontal position. The trunk must be blocked near the ball and tied secure for support. Trunks shall be padded to prevent bruising and tops tied securely to the bed of the truck or trailers.

2. TRANSPORTING

Plants are to be transported by truck or low trailer. Bare-roots shall be covered with moist peat moss, sphagnum, sawdust, straw or wood chips before transporting. Plants shall have their tops tied in and be packed tightly on the truck to prevent shifting, which may cause breaking of the soil ball and branches. Excessive bending of branches must be avoided when tops are tied in or down. All plants with leaves and/or transported long distances shall be transported in an enclosed truck or covered with heavy canvas to prevent wind whipping and drying out while in transit. Plants in leaf shall be covered immediately before being transported and the cover shall be removed immediately after arriving at the planting site to avoid high temperatures which can severely injure the plants.

3. UNLOADING

Hand push carts shall be used to move balled and burlapped plants to the planting hole when unloaded from the truck. Plant material set off at the planting site shall be protected from freezing, drying out, breaking apart, overheating and other injuries. Plants that will not be planted immediately shall be protected from drying by the sun and wind.

Prevention of mechanical damage to plant material (i.e., crown, trunk or roots) and protection of root systems and crowns from drying during transportation, delivering and/or planting shall be the responsibility of the successful bidder(s). Plant materials shall not be removed from storage prior to complete preparation of the planting site for immediate planting.

31.06 LOCATION OF PLANT MATERIAL

A. STREET TREES

A list of designated locations (i.e., addresses) for street trees will be provided by the City's Project Manager when bid(s) has been awarded. Planting locations will be marked by the City with paint or wooden stakes. The Contractor is to inform the City's Project Manager on a daily basis as to what locations have been planted during the prior day and where planting will resume. Access to the planting sites will be restricted to streets for all vehicles. Permission to travel with any equipment anywhere other than the established streets must be obtained from the City's Project Manager.

B. PARK TREES AND OTHER LANDSCAPED AREAS

A list of designated locations for park trees will be provided by the City's Project Manager when bid(s) has been awarded. Planting locations will be marked by the City with paint or wooden stakes. The Contractor is to inform the City's Project Manager on a daily basis as to what locations have been planted during the prior day and where planting will resume. Access to the planting sites will be restricted to streets for all vehicles. Permission to travel with any equipment anywhere other than the established streets must be obtained from the City's Project Manager.

31.07 SITE PREPARATION

The Contractor will be responsible for having all underground utilities properly located prior to digging/planting. Any utility relocates that are necessary will also be the responsibility of the Contractor including any costs associated with them and not the City of Lincoln. Planting sites less than 5' from lateral underground utility lines (i.e. electric, gas, water, etc.) shall require contacting the City's Project Manager so that alternate planting location(s) can be marked.

1. Layout and stake individual tree and shrub locations before start of planting work.
2. Examine proposed planting areas and conditions of installation.
3. Do not start planting until unsatisfactory conditions are corrected.
4. Make minor adjustments as may be necessary or requested.
5. Installation of plant material may not begin until City's Project Manager has approved planting locations.

31.08 PLANTING OF TREES AND SHRUBS

Trees may be moved and planted with an approved mechanical tree spade. The tree spade shall have a manufacturer's size rating equal to or exceeding the tree sizes to be moved. The machine shall be approved by the City's Project Manager prior to use. Trees shall be planted at the designated locations in the manner as shown in the plans and in conformance with sections of the Standard Specifications that are applicable. Tree pits may either be dug manually or mechanically using an auger or tree spade.

Excavate pits, beds and trenches with vertical sides and with bottom slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation and scarify sides.

For balled and burlapped trees and shrubs, scarify bottom of the excavations to a depth of 4". Make excavations equal to the depth of ball, and diameter at least twice as wide as the root ball or root systems to allow enough space to permit loose backfill to be worked down and around the root ball or root system. (Refer to details in Chapter 31, showing root ball in reference to soil line and back-fill)

31.08 PLANTING OF TREES AND SHRUBS (Continued)

Glazing of the sides of the planting pits dug with shovels, mechanical augers, or tree spades shall be minimized by scarifying or roughening before backfilling to provide for easier lateral outward growth of the developing roots. All tree pits shall be backfilled manually.

Planting pits shall be backfilled the same day they are dug. If any planting pits are to be left open when Work is not in process or create a safety hazard to the public, they shall be covered over or properly barricaded.

Plants shall be lifted and handled with suitable support of the soil ball to avoid damage. Container and balled and burlapped plant material shall be lifted, carried and/ or lowered by the root ball, never by the trunk.

Plants shall be set so that the root flare is 1" to 2" above the existing grade. Plants should not be planted deeper than they were in their former growing location. To eliminate settling, the bottom of the planting hole shall be undisturbed soil so that it will give solid support to the bottom of the root ball or root system.

Plants must be plumb (straight) and centered in the planting hole before backfilling and after planting is complete.

Fertilizer shall be an approved root biostimulant (i.e. Roots by City). Apply according to the directions on the label.

If the plant is in a container or pot, the plant shall be carefully removed from the container or pot and the exterior of the root ball manually loosened to encourage roots to grow out into the surrounding soil prior to setting the plant in the planting hole.

If the plant is balled and burlapped all rope, strings, twine, wire, and wrapping from the top 1/2 of the ball shall be removed after the plant has been set in the planting hole.

The balance of the wrapping is to be left intact around the root ball. All waterproof or water repellant wrappings shall be removed entirely from the ball.

If large or numerous rocks, construction debris, fill, tree roots or other obstructions are encountered in digging planting pits, suitable alternate locations shall be selected by the City's Project Manager. Where such obstructions are encountered, the Contractor shall proceed with doing other planting Work at different designated locations and not stop Work. Under no circumstances shall pits that have such obstructions be left open and shall be backfilled by the Contractor before leaving the site.

Planting pits are to be backfilled with the same soil that is excavated from them. Topsoil and subgrade soil shall be loosened and mixed to a depth 12" before backfilling. Topsoil shall be gently firmed around the plant to hold it in place and to eliminate air pockets. When pits are approximately 2/3 full, they are to be thoroughly watered to also eliminate air pockets. After this initial watering, topsoil is to be installed to the top of pit and watered. Puddled soil conditions resulting from over watering are to be avoided.

After the planting pit has been completely backfilled, make a ridge of soil 2" to 4" in height is to be formed around the outside margin of the pit to create a reservoir for watering.

31.08 PLANTING OF TREES AND SHRUBS (Continued)

Top of planting pits are to be mulched with a 2" to 3" layer of wood chips 5' in diameter, immediately after planting. All shrub beds to be mulched as a continuous bed with a natural 6" trench separating the planting area from the turf area.

Plants are to be thoroughly watered immediately after planting. Over watering is to be avoided. Contractor must supply water and equipment needed (e.g., water truck, hose, buckets, etc.) to water trees. Under no circumstances shall water from homes be used by the Contractor to water trees. Watering from fire hydrants may be used only after securing a permit and meter from the City Water Department.

When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify City's Project Manager. Hand excavate near underground utilities. Maintain grade stakes set by other until removal is agreed upon by all parties considered.

31.09 PLANTING PERENNIALS AND ORNAMENTAL GRASSES

Prepare soil at perennial areas by spading deeply to a depth of at least 8" below the finished grade. Add yard waste compost to planting area so that the final planting medium composition is 60% topsoil and 40% compost to the 8" depth. Rake planting bed smooth. Some ornamental grasses may not require compost, so verify with City's Project Manager.

Moisten soil before planting to allow it to dry slightly until workable. Set plants at specified spacing. Do not remove plant from container until it is to be set in planting soil.

Mulch perennial plants. Provide 1" to 1-1/2" thickness of mulch and work into top of backfill and finish level with adjacent grades. Mulch within 24 hours of planting. Thoroughly water mulched areas. All perennial and ornamental grass beds to be mulched as a continuous bed with a natural 6" trench separating the planting area from the turf area. Mulch shall cover all disturbed earth within the planting area.

Plants shall be thoroughly watered immediately after planting. Over watering is to be avoided. Contractor must supply water and equipment needed (e.g., water truck, hose, buckets, etc.) to water trees. Under no circumstances shall water from homes be used by the Contractor to water trees. Watering from fire hydrants may be used only after securing a permit and meter from the City Water Department.

When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify City's Project Manager. Hand excavate near underground utilities. Maintain grade stakes set by other until removal is agreed upon by all parties considered.

31.10 PRUNING OF PLANT MATERIAL

Pruning shall only be done at the time of planting if necessary. All broken, weak and interfering (i.e., crossing or rubbing) branches shall be properly removed by the Contractor after the tree has been planted. Drop crotch pruning shall be done and pruning cuts properly made so that the branch collar and/or branch bark ridge are not cut. All other sound and healthy branches shall be left intact to provide maximum leaf surface to manufacture food for crown and root growth.

31.11 STAKING AND SUPPORT OF PLANT MATERIAL

Wrapping of trunks with tree wrap is not required. All existing tree wrap, if any, shall be removed from trunks immediately after planting.

Staking of all upright deciduous and coniferous trees is required.

Staking shall be required after planting Street Trees and Park Trees. Staking of Street Trees shall be completed immediately after planting unless staking is not specified.

Street Trees are to be secured after planting by two support stakes driven at approximately 90° angle to the ground plane avoiding the root ball. Stakes are to be driven to a minimum depth of 12" into undisturbed soil and contained within the 5' mulched tree ring. Trees should be secured to stakes using nylon webbing configured in a "Figure 8" allowing for flexibility of the tree trunk, while transferring support from the stake to the tree. (Refer to details in Chapter 31.)

Deciduous Park Trees & Trees in other Landscaped Areas are to be secured after planting by two support stakes driven at approximately 90° angle to the ground plane avoiding the root ball. Stakes are to be driven to a maximum depth of 12" into undisturbed soil and contained within the 5' mulched tree ring. Trees should be secured to stakes using nylon webbing configured in a "Figure 8" allowing for flexibility of the tree trunk, while transferring support from the stake to the tree. (Refer to details in Chapter 31.) Tree guards shall be installed on all deciduous trees. The guards shall be plastic and will be provided by the City.

31.12 MARKING PARK TREES

Park trees shall be marked with materials provided by the City to aid in monitoring plantings from year to year. Deciduous trees shall be marked with a circle of spray paint approximately 2" in diameter at the base of the trunk. Coniferous trees shall be marked with a colored tag placed on a side branch, not on the central leader.

31.13 CARE INSTRUCTIONS FOR STREET TREES

Instructions on the care of street trees will be provided by the City for the Contractor to distribute immediately at each planting location. The Contractor is to leave the instructions in the form of a "door hanger" at the door of the adjoining residence or commercial property. Door hangers are not to be placed in mail boxes.

31.14 ACCEPTANCE AND ESTABLISHMENT PERIOD

Upon completion of planting the City's Project Manager will inspect the plant material for acceptability. The Contractor will be notified of the dates of this inspection. All items of Work as required in the Standard Specifications, the Special Provisions, and the plans shall have been performed prior to this inspection. Any item not been completed may make a plant unacceptable. Unacceptable plant material may be allowed to remain in place without payment. A subsequent inspection may be made 30 days subsequent to the initial inspection to determine the acceptability of plant material and therefore, allowing payment for such plants.

31.14 ACCEPTANCE AND ESTABLISHMENT PERIOD (Continued)

During the establishment period, the Contractor shall properly maintain all plant materials planted under the contract. The establishment procedures shall include additional pruning, protective measures against pests and diseases, watering as often as required by necessity, cultivating, repairing damage to the watering basins, replacing mulch which becomes displaced, keeping the stakes firm and the guys adjusted, weeding with a pre-emergent weed control or other approved means, and other establishment procedures as deemed necessary by the City's Project Manager, including the removal of any dead plant material for the project. The Contractor is responsible for watering all plant material as necessary during the one-year establishment period.

The establishment period will follow the completion of all planting and shall extend for a period of one year. The establishment period will not begin until all of the following items of Work as required in the Standard Specifications, the Special Provisions, and the plans have been performed on each and every plant material; including proper planting, backfilling, watering, pruning, staking, supporting, water basin construction and mulching. All plant material shall be in viable growing condition when the project enters the establishment period.

Upon completion of the establishment period, the City's Project Manager will inspect the plant material to identify plant material to be replaced under warranty. The inspection will normally be made during the month that the establishment period terminates. The Contractor will be notified of the dates of this inspection. A list of plant material quantities and locations will be provided to the Contractor for replacement. Replacement of plant materials shall occur within 30 days of receipt of this list. Plant replacement shall be at the Contractor's expense. Establishment procedures that have not been performed shall be brought to the Contractor's attention and may cause the establishment period to be extended. All replacement plant material shall receive the establishment procedures referred Chapter 31. The Contractor will be notified in writing when his/her establishment responsibilities on the acceptable plant material have been terminated.

31.15 REPLACEMENT OF PLANT MATERIAL AND GUARANTEE PERIOD

The Contractor shall guarantee all plant material to be in healthy and flourishing condition for a period of 1 year from date of acceptance. The guarantee period for trees shall begin at the date of acceptance.

The Contractor shall replace, without cost, and as soon as weather conditions permit and within a specific planting period, all plants determined by the City's Project Manager to be dead during or at the end of the guarantee period.

During the guarantee period, the City shall properly maintain all plant materials planted under the contract. The establishment procedures shall include additional pruning, protective measures against pests and diseases, watering as often as required by necessity, cultivating, repairing damage to the watering basin, replacing mulch which becomes displaced, keeping the stakes firm and support ties adjusted, weeding with a pre-emergence weed control or other approved means and other establishment procedures as deemed necessary by the City's Project Manager including the removal of any dead plant material from the project.

31.15 REPLACEMENT OF PLANT MATERIAL AND GUARANTEE PERIOD (Continued)

Replacement plants shall be free of dead or dying branches and branch tips shall bear foliage of normal density, size and color if in leaf. Replacements shall closely match adjacent specimens of the same species that have been planted. Replacements shall be subject to all requirements, standards, special provisions and Standard Specifications stated herein.

The guarantee of all replacement plants shall extend for an additional period of 1 year from date of their acceptance and installation. In the event that replacement plants are not acceptable during or at the end of the said extended guarantee period, the City's Project Manager may elect subsequent replacement or credit (refund) for them.

31.16 VANDALISM

Trees damaged as a result of vandalism are not required to be replaced as apart of this contract.

31.17 QUALIFICATIONS FOR SUBMITTING BIDS

To submit bids, a Contractor must have all of the following qualifications and certification:

- Be licensed according to the Nebraska Administrative Code for Plant Protection and Plant Pest Act.
- Be a Nebraska Certified Nurseryman and a current member of the Nebraska Nursery and Landscape Association.
- Be able to demonstrate a minimum work experience record.
- Be able to demonstrate successfully completed projects similar to scope and scale.

CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 32

EROSION AND SEDIMENT CONTROL

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CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 32

EROSION AND SEDIMENT CONTROL

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CHAPTER 32

EROSION AND SEDIMENT CONTROL

32.00 GENERAL

This Work shall consist of constructing, maintaining, and removing erosion control measures that are used to minimize erosion and sedimentation during construction. This Work shall be performed at locations shown on the plans or as directed by the City's Project Manager.

32.01 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT

A. GENERAL

The Contractor shall understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the stormwater discharges associated with the industrial activity from the construction site. For reference the general permit is posted on the City's web site, www.lincoln.ne.gov; keyword: NPDES.

Additionally, the Contractor, as evidenced by their signature on this proposal, agrees and understands that, if awarded the contract on this project, he/she:

- shall obtain authorization of a CSW-NOI (Notice of Intent) Permit from the Nebraska Department of Environment and Energy; and
- is legally bound to comply with the Clean Water Act to ensure compliance with the terms and conditions of the stormwater pollution prevention plan as developed under the NPDES permit and the terms of the NPDES permit; and
- will hold owners harmless for damages and fines arising as a result of noncompliance with the terms of the stormwater permits and authorizations associated with the work on this project; and
- shall be responsible for the maintenance of the sediment control measures until permanent stabilization and cover crop is established; and
- shall complete permanent or temporary stabilization within 7 calendar days of soil disturbance to the surface of all perimeter controls, topsoil stockpiles, and any other disturbed or graded areas on the project site which are not being used for material storage, or on which actual earth moving activities are not being performed; and
- shall complete the approved inspection forms and inspect/maintain all sediment or erosion control practices required under this contract at least once every 14 calendar days and after any storm event of greater than 0.5" of precipitation, on the site, during any 24-hour period; any necessary repairs or cleanup to maintain the effectiveness of the best management practices shall be made by contractor immediately; and
- shall update the approved SWPPP plan immediately following any changes or additions to the plan. Copies of all inspection forms and modifications to the SWPPP plan should be made available online at <https://ecmp.nebraska.gov/DEQ-CSW/Account/Login?ReturnUrl=%2fDEQ-CSW> within 48 hours of inspection.
- shall complete a Notice of Termination (NOT) upon completion of all construction activities and final site stabilization requirements. Final stabilization shall be defined as 70% native background perennial vegetation on the entire project and all sediment and erosion control Best Management Practices (BMP's) have been removed.

32.01 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT
(Continued)

B. BASIS OF PAYMENT

Payment for updating the approved SWPPP, performing the required inspections, and maintaining the appropriate documentation shall be paid for at the contract unit price bid per each (EA), per occurrence for SWPPP UPDATING. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the inspection, updating and documentation activities listed above.

Payment for maintenance of the sediment and erosion control devices will be as given below in the individual sections.

32.02 SYNTHETIC FABRIC SEDIMENT FENCE

A. GENERAL

Sediment fence is a temporary linear sediment filter barrier constructed of synthetic filter fabric and posts. Sediment fence shall be used for detaining small amounts of sediment and decreasing flow velocities.

B. MATERIALS

1. Sediment fence shall be a pervious sheet of propylene, nylon, polyester or ethylene fabric and shall conform to the Standard Specifications defined in the following table:

TABLE 32.02 A – SEDIMENT FENCE REQUIREMENTS

Fabric Properties	Minimum Requirements	Test Method
Filtering Efficiency	70%	ASTM 5141
Tensile Strength at 20% (max.) elongation:	30 lb./linear inch	ASTM 4632
Standard Strength		
High Strength	50 lb./linear inch	ASTM 4632
Flow Rate	.2 gal./SF/minute	ASTM 5141
Ultraviolet Radiation Stability	90%	ASTM-G-26

2. Posts and stakes shall be standard “T” steel posts and be a minimum of 40" in length.

32.02 SYNTHETIC FABRIC SEDIMENT FENCE (Continued)

C. INSTALLATION

Sediment fence shall be placed the same day excavating and/or fill is placed and prior to any site disturbing activities upstream of the fence.

Sediment fence can be installed either by trenching or by utilizing a sediment fence installation machine. If trenching is used sediment fence can be entrenched by excavating a 4" wide trench along the line of the fence posts, with the filter fabric being entrenched to a depth of no less than 8". The trench must be backfilled and compacted on both sides of the sediment fence.

If a sediment fence installation machine is utilized the sediment fence must be installed at a minimum depth of 10" into the ground.

Maximum drainage area for overland flow to a silt fence shall not exceed one-quarter acre per one hundred feet of fence.

J Hooks shall be installed at a minimum of 100' intervals that may run along silt fence sections to intercept and trap flows and reduce parallel erosion failures.

Posts shall be driven into the ground to a minimum depth of 16" below the original ground level and at approximately a 20° incline toward the upslope side. The posts shall be spaced a maximum of 6' apart for filter fabric not supported by wire mesh and a maximum of 10' apart for filter fabric supported by wire mesh.

When using steel T posts, the "nubbed" side of the post needs to be on the surface side of the fence post.

When joints are necessary, sediment fence shall be spliced together only at a support post, with a minimum 6" overlap. The overlap shall be secured as necessary.

These requirements represent minimum installation requirements and do not replace the sediment fence manufacturer installation recommendations that may exceed these requirements.

For details see LSP 175.

D. MAINTENANCE AND REMOVAL

Sediment deposits shall be removed when the level of deposition reaches 1/2 of the sediment fence height. Removed sediment shall be placed in a suitable location and in a manner that minimizes further erosion.

If, during required inspections, damage to the sediment fence is observed the necessary repairs shall be completed within 24 hours of the inspection.

The sediment fence shall not be removed until the up-slope area has been permanently stabilized and/or directed by the City's Project Manager. All materials shall be completely removed from the site and stored or disposed of properly.

32.02 SYNTHETIC FABRIC SEDIMENT FENCE (Continued)

E. BASIS OF PAYMENT

Installation shall be paid for at the contract unit price per linear foot (LF) for SYNTHETIC FABRIC SEDIMENT FENCE INST. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the Work.

Maintenance shall be paid for at the contract unit price bid per linear foot (LF), per occurrence for SYNTHETIC FABRIC SEDIMENT FENCE MAINT. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the maintenance activities listed in these Standard Specifications.

Removal shall be paid for at the contract unit price bid per linear foot (LF), per occurrence for SYNTHETIC FABRIC SEDIMENT FENCE REM. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the removal activities listed in these Standard Specifications.

32.03 CONSTRUCTION ENTRANCE

A. GENERAL

A construction entrance is a stabilized aggregate pad with a filter fabric underline located at any point where vehicular traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area. Its purpose is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets. It should be used wherever traffic will be leaving a construction site and moving directly onto a public street or other paved area.

B. MATERIALS

1. The aggregate shall be 2" to 3 1/2" diameter, clean crushed rock. Crushed concrete is unacceptable per the Drainage Criteria Manual Chapter 9.
2. Filter fabric shall be resistant to commonly encountered chemicals, hydrocarbons, mildew, rot-resistant, and conform as a minimum to the fabric properties shown in the following table:

TABLE 32.03 A – FILTER FABRIC PROPERTIES

	Fabric Properties	Testing Method
Grab Tensile Strength (lbs)	250	ASTM D4632
Elongation A Failure (%)	60	ASTM D4632
Mullen Burst Strength (psi)	380	ASTM D3786
Puncture Strength (lbs)	125	ASTM D4833
Apparent Opening Size (mm)	.20	ASTM D4751

Fabrics not meeting these Standard Specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

32.03 CONSTRUCTION ENTRANCE (Continued)

C. INSTALLATION

The minimum width of the entrance shall be 12' for sites with multiple access points and 24' for sites with a single access point. The minimum length of the entrance shall be 70'.

The area of the construction entrance shall be excavated a minimum of 3" and shall be cleared of all vegetation, roots, and other objectionable material. The filter fabric shall be placed the full length and width of the construction entrance.

Following the placement of the filter fabric, the aggregate shall be placed over the entire length and width of the construction entrance at a thickness not less than 6". A 3' wide by 6" high mountable berm of additional aggregate may be placed across the entire width of the construction entrance at the connection to the existing street or paved area.

For application, design, and dimension details refer to LSP 176.

D. MAINTENANCE AND REMOVAL

The entrance shall be maintained in a condition which will prevent tracking or flow of sediment onto public right-of-way. This may require periodic top dressing with additional aggregate or the washing and reworking of existing aggregate as conditions demand and repair and/or cleanout of any structures used to trap sediment.

All materials spilled, dropped, washed, or tracked from vehicles onto streets or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto streets will not be permitted under any circumstances.

The construction entrance shall not be removed from the site and maintenance shall not cease until the site construction is sufficiently complete such that exiting traffic will no longer track material onto the public street or paved area. All filter fabric, aggregate, and any other materials used in the construction of the entrance shall be completely removed from the site and disposed of properly.

E. BASIS OF PAYMENT

Installation of the construction entrance shall be paid for at the contract unit price per ton for CONSTRUCTION ENTRANCE SURFACING. The filter fabric shall be subsidiary to the construction of the entrance. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for installation, maintenance, and removal of the Work.

32.04 INLET PROTECTION

A. GENERAL

Inlet protection is a temporary filter installed around inlets, ponding water and thereby reducing the sediment passing through into the storm sewer. Its purpose is to minimize the amount of sediment entering storm drainage systems prior to permanent stabilization of the disturbed area.

32.04 INLET PROTECTION (Continued)

B. MATERIALS

1. Filter Fabric Inlet Protection shall be constructed of a pervious sheet of propylene, nylon, polyester or ethylene fabric as specified above for Synthetic Fabric Sediment Fence. Posts and framing material shall be wooden posts with a minimum height of 30", and framing boards with a cross sectional area of 5 1/4 square inches (standard 2" x 4") or larger. Metal posts shall be standard steel "T" post with a minimum height of 40", or approved equivalent.
2. Curb Inlet Protection shall be made of permeable, durable, high strength geotextile filled with filtering media, of sufficient size to accommodate the inlet, and permeable enough to pass high flow rates of storm water.

C. INSTALLATION

1. Installation of Filter Fabric Inlet Protection (Types II and III) around inlet vaults and grate inlets shall consist of stakes spaced evenly with a maximum spacing of 3' around the entire perimeter of the inlet and placed no closer than 12" to the nearest face of the inlet. Stakes shall be securely driven into the ground to a minimum depth of 12" for wooden stakes and 16" for metal stakes. Stakes shall extend a minimum of 18" above the ground for wooden stakes and 24" for metal stakes.

Where wooden stakes are used, wooden frames shall be constructed and securely attached to the stakes. One frame shall be flush with the top of the stakes and one frame shall be located approximately 4" above the ground.

The filter fabric shall be cut from a continuous roll to minimize weakness at joints. The bottom of the filter fabric shall be placed in a trench at a minimum depth of 6" and backfilled completely with compacted soil. Filter fabric shall be securely attached to the stakes and frames by staples or wire. The joint shall be overlapped to the next stake.

A temporary dike shall be placed on the down slope side of the structure in locations that are subject to bypass flow.

The storm drain inlet protection shall be constructed and complete as soon as the storm drain inlet might accept runoff.

2. Installation of the Curb Inlet Protection (Type I) shall be as per plan or manufacturer's recommendation in a manner that ponds water and filters sediment from the water entering the curb inlet, but not in a manner that completely plugs the inlet, causes flooding outside of public right-of-way, or unsafe driving conditions. This may include but not be limited to:
 - a. installation in front of the curb inlet opening in a manner that blocks sediment laden water from directly entering the storm sewer system while allowing for ponded water to overflow into the storm sewer system during large rain events to prevent localized flooding. A spacer is required in order to keep the Curb Inlet Protection directly away from the drain opening.
 - b. inlet protection is not to be installed on motoring streets that are open to through traffic, and/or if necessary, must be removed at the end of each day of construction.

32.04 INLET PROTECTION (Continued)

D. MAINTENANCE AND REMOVAL

If during required inspections damage to the structure is observed, the necessary repairs shall be completed within 24 hours of the inspection. Sediment deposits shall be removed when the level of deposition reaches 1/3 of the structure height. Removed sediment shall be placed in a suitable location and in a manner that minimizes further erosion. If the curb inlet protection device becomes clogged with debris and sediment, they shall be maintained so as to assure proper drainage and water flow into the storm drain. The structure shall not be removed until the up-slope area has been permanently stabilized, or as directed by the City's Project Manager. All materials shall be completely removed from the site and stored or disposed of properly.

E. BASIS OF PAYMENT

Payment for the Installation, Maintenance and Removal of Filter Fabric Inlet Protection shall be subsidiary to the construction of the inlet and shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the installation, maintenance and removal Work.

Payment for the installation of Curb Inlet Protection shall be paid for at the contract unit price per each (EA), per occurrence for CURB INLET PROTECTION INST. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the Work.

Payment for the maintenance of Curb Inlet Protection shall be paid for at the contract unit price bid per each (EA), per occurrence for CURB INLET PROTECTION MAINT. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the maintenance activities listed above.

Payment for the removal of the Curb Inlet Protection shall be paid for at the contract unit price bid per each (EA), per occurrence for CURB INLET PROTECTION REM. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the removal activities listed above.

32.05 EROSION CONTROL BLANKET (ECB)

A. GENERAL

Erosion Control Blankets are a temporary, degradable rolled erosion control product composed of natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.

B. MATERIALS

1. Erosion Control Blanket, Type I shall be constructed of 100% agricultural straw evenly distributed across the entire blanket, covered with a photodegradable polypropylene net having an approximate 0.5" x 0.5" net opening, a mass per unit area of 0.40 lbs/sy, and a functional longevity of 12 months.

32.05 EROSION CONTROL BLANKET (ECB) (Continued)

B. MATERIALS (Continued)

2. Erosion Control Blanket, Type II shall be constructed with 70% agricultural straw and 30% coconut fiber evenly distributed across the entire blanket, stitched with degradable thread between a heavy weight UV stabilized polypropylene top net with an approximate 0.63" x 0.63" net opening, and a lightweight photodegradable polypropylene bottom net, having an approximate 0.5" x 0.5" net opening, a mass per unit area of 0.5 lbs/sy and a functional longevity of 24 months.
3. BD Erosion Control Blanket, Type I shall be constructed with 100% biodegradable materials containing a 100% agricultural straw fiber matrix evenly distributed across the entire blanket, covered with a biodegradable natural organic fiber netting having an approximate 0.5" x 1.0" net opening, a mass per unit area of 0.47 lbs/sy, and a functional longevity of 12 months.
4. BD Erosion Control Blanket, Type II shall be constructed with 100% biodegradable materials containing 70% agricultural straw and 30% coconut fiber matrix evenly distributed across the entire blanket, covered on the top and bottom with biodegradable natural organic fiber netting having an approximate 0.5" x 1.0" net opening, a mass per unit area of 0.6 lbs/sy and a functional longevity of 18 months.
5. Metal staples for installation shall be No. 11 gauge wire and at least 6" long.
6. 100% natural fasteners shall be at least 6" long.

C. INSTALLATION

Installation shall occur as soon as possible after finish grading operations and/or seeding have been complete, or as directed by the City's Project Manager. On shallow slopes, less than 4H:1V, the blankets may be installed parallel across the slope. On steep slopes, 4H:1V or greater, the blankets shall be installed perpendicular down the slope. In ditches and drainage channels the blankets shall be installed parallel to the direction of flow and in such a manner as to avoid seams along the channel bottom. Entrenchment and overlap shall be as recommended by the manufacturer.

Staples or fasteners will be placed according to the manufacturer. The installation procedures shall ensure that the Erosion Control Blanket will remain in intimate contact with the soil for its period of functional longevity or until such time as full growth of the vegetation occurs. In loose soils, staples or fasteners of greater than 6" may be required to properly secure the blanket. 100% natural fasteners will be required when securing biodegradable blankets.

For application and design details see LSP 179.

D. MAINTENANCE

If, during required inspections, erosion or undermining beneath the blanket is observed, the blanket shall be pulled back and any lost soil shall be replaced and the area shall be reseeded. After reseeding, the blanket shall be reinstalled as detailed above. Maintenance shall be completed within 24 hours of inspection if site conditions are conducive.

32.05 EROSION CONTROL BLANKET (ECB) (Continued)

E. BASIS OF PAYMENT

Erosion Control Blanket shall be paid for at the contract unit price bid per square yard (SY) for ECB, Type I and ECB, Type II and BD ECB, Type I and BD ECB, Type II as measured by the visible surface area after installation is complete. This price shall be full compensation for furnishing, preparing, transporting, delivering and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the installation and maintenance of the Work.

32.06 TURF REINFORCEMENT MAT (TRM)

A. GENERAL

Turf Reinforcement Mat is a rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh, and/or other elements, processed into a permanent, three-dimensional matrix of sufficient thickness. TRMs may be supplemented with degradable components. They provide long-term functionality by permanently reinforcing vegetation during and after maturation.

B. MATERIALS

1. Turf Reinforcement Mat, Type I shall be constructed of 100% coconut fiber matrix with a mass per unit area of 0.5 lbs/sy and a functional longevity of 36 months, incorporated into a permanent three-dimensional matting. The matrix shall be stitch bonded, with a UV stabilized polypropylene thread, between a super heavy-duty UV stabilized bottom net with an approximate 0.5" x 0.5" net opening, an ultra duty UV stabilized, dramatically crimped intermediate netting with an approximate 0.5" x 0.5" net opening, and covered by a super heavy-duty UV stabilized top net with an approximate 0.5" x 0.5" net opening. The crimped netting shall form prominent closely spaced ridges across the entire width of the mat.
2. Turf Reinforcement Mat, Type II shall be constructed of 100% UV stabilized polypropylene fiber matrix incorporated into a permanent 3-dimensional turf reinforcing matting. The matrix shall be evenly distributed across the entire mat with a mass per unit area of 0.5 lbs/sy. The matrix shall be stitch bonded, with a UV stabilized polypropylene thread, between ultra heavy-duty UV stabilized bottom, intermediate and top nettings with approximate 0.5" x 0.5" net opening. The intermediate netting shall be dramatically crimped and shall form prominent closely spaced ridges across the entire width of the mat.
3. Staples for installation shall be No. 11 gauge wire and at least 6" long.

C. INSTALLATION

Installation shall occur as soon as possible after finish grading operations and/or seeding have been complete, or as directed by the City's Project Manager. On shallow slopes, less than 4H:1V, the mats may be installed parallel across the slope.

On steep slopes, 4H:1V or greater, the mats shall be installed perpendicular down the slope. In ditches and drainage channels the mats shall be installed parallel to the direction of flow and in such a manner as to avoid seams along the channel bottom. Entrenchment and overlap shall be as recommended by the manufacturer.

32.06 TURF REINFORCEMENT MAT (TRM) (Continued)

C. INSTALLATION (Continued)

Staples will be placed according to the manufacturer. The installation procedures shall ensure that the Turf Reinforcement Mat will remain in intimate contact with the soil for its period of functional longevity or until such time as full growth of the vegetation occurs. In loose soils, staples of greater than 6" may be required to properly secure the mat.

For application and design details see LSP 179.

D. MAINTENANCE

If, during required inspections, erosion or undermining beneath the mat is observed, the mat shall be pulled back and any lost soil shall be replaced and the area shall be reseeded. After reseeding, the mat shall be reinstalled as detailed above. Maintenance shall be completed within 24 hours of inspection if site conditions are conducive.

E. BASIS OF PAYMENT

Turf Reinforcement Mat shall be paid for at the contract unit price per square yard (SY) for TRM, TYPE I and TRM, TYPE II as measured by the visible surface area after installation is complete. This price shall be full compensation for furnishing, preparing, transporting, delivering and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the installation and maintenance of the Work.

32.07 SEDIMENT BARRIERS

A. GENERAL

Sediment barriers function by intercepting and ponding sediment-laden runoff. Ponding the water reduces the velocity of the incoming flow and allows most of the suspended sediment to settle out. Water exits the check by flowing over the top or through the filter medium. Sediment barriers can be used as ditch checks or continuous sediment barriers.

B. MATERIALS

1. Flexible Triangular Sediment Barriers shall be triangular in shape, having a height of at least 9" in the center with equal sides and at least a 16" wide base. The triangular-shaped inner material shall be urethane foam. The outer cover shall be a woven geotextile fabric placed around the inner material and allowed to extend beyond both sides of the triangle at least 30". Standard length of each barrier will be 7' unless otherwise indicated on the plans.

Staples shall be No. 11 gauge wire and be at least 8" long or per manufactures Specifications, whichever is greater.

2. Permeable A-Shaped Sediment Barrier is a permeable, high porosity A-Shaped rigid plastic berm with basic dimensions of 9" in height and 3' in length. The permeable A-shaped barrier shall be installed on top of a turf reinforcement meeting specifications given above for TRM, Type I.

The permeable A-shaped berm shall be installed with galvanized ardox spikes 10" long using galvanized washers at intervals or per manufactures Specifications, whichever is greater.

3. Temporary Earth/Soil Berms can consist of excavated soil material on site.

32.07 SEDIMENT BARRIERS (Continued)

B. MATERIALS (Continued)

4. Earth-Slash Mulch Check can consist of onsite waste material from clearing and grubbing. Material shall consist of coarse pieces with a minimum length of 3".

C. INSTALLATION

Sediment barriers shall be installed in locations and configuration as shown on the approved erosion and sediment control plan or as directed by the City's Project Manager.

1. For installation of flexible triangular sediment barriers, a 4" wide by 4" deep trench shall be excavated perpendicular to the storm water flow. The trench shall extend in a straight line along the entire length of the proposed triangular sediment barrier installation.

The triangular sediment barrier shall be installed such that the elevation of the ground at both ends of the barrier is higher than the elevation of the top of the barrier at the center of the ditch. This prevents the storm water from flowing around the barrier.

Triangular sediment barriers shall be constructed prior to or the same day that land disturbance activities are performed up slope of the triangular sediment barriers

Each triangular sediment barrier has two aprons: one upstream and one downstream. The upstream apron is the shorter of the two. Place the triangular sediment barrier on the downstream side of the trench. Conform the flexible triangular sediment barrier to the contour of the ground or the geometry of the ditch so that no space exists between the barrier and the ditch bottom. Place the first 4" to 6" of the upstream apron in the trench and anchor it with one row of staples on 18" centers at the bottom of the trench angled slightly toward the downstream side. Place an additional row of staples on 18" centers and at changes in grade along the full length of the barrier at the upstream edge of triangular portion of the barrier. The downstream apron, (which folds under the base of the triangular sediment barrier) should terminate freely on the downstream side of the triangular silt barrier. No trench is needed for the downstream apron. The downstream apron shall be anchored with two rows of staples placed on 18" centers.

One row shall be placed where the downstream apron meets the base of the barrier on the downstream side, and the other row should be placed at the downstream edge of the apron.

At joints between sections of the barriers, the ends of the barrier sections shall be placed such that there is no space between the foam materials. The excess fabric at the ends of the barrier sections shall be extended over the adjoining sections and stapled together along the full length of the joint.

When all the sections have been anchored with staples accordingly the trench shall be backfilled with compacted soil.

32.07 SEDIMENT BARRIERS (Continued)

C. INSTALLATION (Continued)

2. For installation of permeable A-shaped sediment barriers, grade surface in preparation for seeding, removing all debris and large clumps of dirt and seed in locations where indicated on the plans. Install erosion control blanket at sediment barrier locations. Install erosion control blanket 3' wide, perpendicular to the direction of flow, centered under the barrier location. Allow 4" slack across the blanket width for folding over upstream foot of the barrier.

Trench in and staple the upstream edge of the blanket, recompact soil into the trench. Place sediment barrier units perpendicular to the flow, centered over the erosion control blanket, overlap units by 2". Secure using spikes and washers through the folded erosion control blanket and the foot of the unit. The pins shall be spaced across the entire width of the panel at 10" on center for the upstream leg and 20" on center for the downstream leg.

The permeable A-shaped berm shall be installed with galvanized Ardox spikes 10" long using galvanized washers at intervals or per manufactures Specifications, whichever is greater.

3. For installation of a temporary earth/soil berm, the berm shall have a minimum height of 18" and should be twice as wide it is high. Berms must be substantial enough to maintain their structural integrity while handling incoming flows. Install berms on the contour perpendicular to sheet flow with the ends turned upslope to prevent runoff from bypassing the berm.
4. For installation of an earth-slash mulch check, the berm shall have a minimum width of 4' and a minimum height of 1' 6".

For application and design details see LSP 180.

D. MAINTENANCE AND REMOVAL

The Contractor shall inspect all sediment barriers after each rainfall event of at least 0.5 inches or greater. Any deficiencies or damage shall be repaired by the Contractor. If the barriers are damaged or inadvertently moved during the silt removal process, the contractor shall immediately replace the barriers after damage occurs.

Sediment deposits shall be removed when the level of deposition reaches 1/2 of the structure height. Removed sediment shall be placed in a suitable location and in a manner that minimizes further erosion.

If, during required inspections, damage to the structure is observed the necessary repairs shall be completed within 24 hours of the inspection.

The structure shall not be removed until the up-slope area has been permanently stabilized and/or directed by the City's Project Manager. All materials shall be completely removed from the site and stored or disposed of properly, unless the engineer approves a suitable disposal area within the project limits.

All ground disturbed by the removal of the structure shall be graded flush with the surrounding ground and stabilized with vegetative cover.

32.07 SEDIMENT BARRIERS (Continued)

E. BASIS OF PAYMENT

Installation shall be paid for at the contract unit price per linear foot (LF) for TRIANGULAR SEDIMENT BARRIER INSTALL, PERMEABLE A-SHAPED SEDIMENT BARRIERS INSTALL, TEMPORARY EARTH/SOIL BERM INSTALL AND EARTH-SLASH MULCH CHECK INSTALL. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the Work.

Maintenance shall be paid for at the contract unit price bid per linear foot (LF) for TRIANGULAR SEDIMENT BARRIER MAINT., PERMEABLE A-SHAPED SEDIMENT BARRIER MAINT., TEMPORARY EARTH/SOIL BERM MAINT. AND EARTH-SLASH MULCH CHECK MAINT. This price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in theses Standard Specifications.

Removal shall be paid for at the contract unit price bid per linear foot (LF) for TRIANGULAR SEDIMENT BARRIER REM., PERMEABLE A-SHAPED SEDIMENT REM., TEMPORARY EARTH/SOIL BERM REM AND EARTH-SLASH MULCH CHECK REM. This price shall be full compensation for removal, disposal of structures and any trapped sediment, cleaning the site, and any and all labor, tools, equipment, and incidentals necessary to complete the Work.

32.08 ROCK DITCH CHECK

A. GENERAL

Rock ditch checks are small temporary dams constructed across a swale or drainage ditch for the purpose of reducing velocity of concentrated stormwater flows and to pond water, thereby reducing erosion of the swale or ditch and promoting settling of suspended solids behind the ditch check.

B. MATERIALS

Rock ditch checks shall typically be a maximum of 3' in height, have a minimum top width of 2' measured in the direction of flow with maximum side slopes of 2:1. The upstream half of the rock check dam should be constructed of 2" to 3" stone (breaker run) placed against Type A rock rip-rap for the downstream half of the check. Stone ditch checks shall be underlain with geotextile filter fabric. An erosion control blanket shall be placed at the base of the ditch check, extending 6' downstream to prevent scour and washing out the toe of the check.

C. INSTALLATION

Rock ditch checks shall be installed in locations and configuration as shown on the approved erosion and sediment control plan or as directed by the City's Project Manager.

For installation of ditch checks, finish grading ditch or channel to final shape and grades, removing all debris and large clumps of dirt. Dig a 6" deep trench at the location of the check to key it into the soil. Install geotextile fabric at the location of the check.

Install erosion control blanket so that it overlaps the geotextile fabric by 1' and will be held in place by rock. Staple fabric to soil as per manufacturer's Specifications. Install rock rip-rap for the downstream half of rock check. Install 2" to 3" breaker run stone for the upstream half of the rock check.

Ditch checks shall be utilized during rough grading and shall be removed once final grading and channel stabilization is applied, unless intended to be part of a permanent stormwater management plan.

Rock checks shall be installed such that the elevation of the ground at both ends of the check is higher than the elevation of the top of the check at the center of the ditch. This prevents the storm water from flowing around the barrier.

Rock checks shall be constructed prior to or the same day that land disturbance activities are performed up slope of the triangular sediment barriers.

32.08 ROCK DITCH CHECK (Continued)

D. MAINTENANCE AND REMOVAL

Sediment deposits shall be removed when the level of deposition reaches 1/2 of the structure height. Removed sediment shall be placed in a suitable location and in a manner that minimizes further erosion.

If, during required inspections, damage to the structure is observed the necessary repairs shall be completed within 24 hours of the inspection.

The structure shall not be removed until the up-slope area has been permanently stabilized. All materials shall be completely removed from the site and stored or disposed of properly. All ground disturbed by the removal of the structure shall be graded flush with the surrounding ground and stabilized with vegetative cover.

E. BASIS OF PAYMENT

Installation shall be paid for at the contract unit price per linear foot (LF) for ROCK DITCH CHECK INST. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the Work.

Maintenance shall be paid for at the contract unit price bid per linear foot (LF) for ROCK DITCH CHECK MAINT. This price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in these Standard Specifications.

Removal shall be paid for at the contract unit price bid per linear foot (LF) for ROCK DITCH CHECK REM. This price shall be full compensation for removal, disposal of structures and any trapped sediment, cleaning the site, and any and all labor, tools, equipment, and incidentals necessary to complete the Work.

32.09 COMPOST FILTER SOCK

A. GENERAL

A compost filter sock is a type of contained compost filter berm. It is a mesh tube filled with composted material that is placed perpendicular to sheet-flow runoff to control erosion and retain sediment in disturbed areas.

Compost filter socks are generally placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. Additionally, they can be laid adjacent to each other, perpendicular to stormwater flow, to reduce flow velocity and soil erosion. Filter socks can also be used on pavement as inlet protection for storm drains and to slow water flow in small ditches.

B. MATERIALS

1. The compost filter sock is oval to round in cross section and provides a three-dimensional filter that retains sediment and other pollutants. They are assembled by tying a knot in one end of the mesh sock, filling the sock with the composted material (usually using a pneumatic blower), and then knotting the other end once the desired length is reached. Filter socks used for erosion control are typically 12" in diameter. Filter socks used for stormwater inlet protection on pavement are typically 8" in diameter, but compressed so that the top of the filter sock is lower than the top of the curb. See the following table for minimum sock diameters based on slope and slope length:

TABLE 32.09 A – COMPOST FILTER SOCK SIZES

Slope	Slope Length	Sock Diameter
<50:1	250'	12"
50:1-10:1	125'	12"
10:1-5:1	100'	12"
3:1-2:1	50'	18"
>2:1	25'	18"

2. Composts used shall be weed free and derived from a well-decomposed source of organic matter. The compost shall be produced using an aerobic composting process meeting CFR 503 regulations, and meet all local, state, and Federal quality requirements. The compost shall be free of any refuse, contaminants or other materials toxic to plant growth, in addition to meeting the following:
 - a. pH of 5.0 – 8.0.
 - b. Particle size with 99% passing a 2" sieve and 30% passing the 3/8" sieve.
 - c. Moisture content of less than 60%.
 - d. Material shall be relatively free (<1% by dry weight) of inert or foreign man-made materials.
3. Wood Stakes shall be a minimum of 2" x 2" long non-treated hard wood.

C. INSTALLATION

Compost filter socks shall be placed at locations indicated on the plans and as directed by the City's Project Manager. They should be placed parallel to the base of the slope or other affected area, perpendicular to the sheet flow, and as frequently as is necessary to break-up the slope length. No trenching is required, but the compost sock should be uniformly contacting the ground surface. This may require cutting or removing heavy vegetation, and or leveling uneven surfaces. Once the filter sock is filled and put in place, it should be anchored to the slope by driving 2" x 2" wooden stakes through the center of the sock at regular intervals or placing stakes on the downstream side of the filter sock.

32.09 COMPOST FILTER SOCK (Continued)

C. INSTALLATION (Continued)

The stakes shall be placed at no greater than 10' lineal spacing. The stake should be driven into solid ground a minimum of 12". The top of the stake should be at least 3" above the top of the filter sock. The ends of the filter sock should be directed upslope to prevent stormwater from running around the end of the sock.

If used as curb inlet protection, the compost filter sock shall be installed as given in the Curb Inlet Section of these Standard Specifications.

D. MAINTENANCE AND REMOVAL

If during required inspections damage to the structure is observed, the necessary repairs shall be completed within 24 hours of the inspection.

Sediment deposits shall be removed when the level of deposition reaches 1/2 of the structure height. Removed sediment shall be placed in a suitable location and in a manner that minimizes further erosion. Alternatively, the City's Project Manager may approve the placement of an additional filter sock placed immediately on top of the existing sediment laden filter sock. If the filter sock becomes clogged with debris and sediment, they shall be maintained so as to assure proper drainage. The structure shall not be removed until the up-slope area has been permanently stabilized. All materials shall be completely removed from the site and stored or disposed of properly. The compost may be dispersed of on-site at locations approved by the City's Project Manager.

E. BASIS OF PAYMENT

Payment for the installation of Compost Filter Sock shall be paid for at the contract unit price per linear foot (LF) for COMPOST FILTER SOCK INST. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the Work.

Payment for the maintenance of Compost Filter Sock shall be paid for at the contract unit price bid per liner foot (LF) for COMPOST FILTER SOCK MAINT. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the maintenance activities listed above.

Payment for the removal of the Compost Filter Sock shall be paid for at the contract unit price bid per liner foot (LF) for COMPOST FILTER SOCK REM. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the removal activities listed above.

32.10 BIODEGRADABLE LOG (WATTLE) DITCH CHECK

A. GENERAL

Erosion control fiber rolls commonly known as Wattles, are elongated tubes of compacted straw and/or other fibers that are installed along contours or at the base of the slopes to help reduce soil erosion and retain sediment. They function by shortening slope length, reducing runoff water velocity, trapping dislodged soil particles and ameliorating the effects of slope steepness.

32.10 BIODEGRADABLE LOG (WATTLE) DITCH CHECK (Continued)

A. GENERAL (Continued)

Wattles are used as water flow dissipaters trapping sediment when located prior to Drain Inlets, etc. Wattles are highly effective when they are used in combination with other surface soil erosion/re-vegetation practices such as surface roughening, straw mulching, erosion control blankets, hydraulic mulching and application of bonded fiber matrix or other hydraulic soil stabilizers.

B. MATERIALS

Wattles shall be a straw-filled tube of flexible netting material exhibiting the following properties. It shall be a machine-produced tube of compacted straw, rice or wheat straw, excelsior, coir, or coconut that is Certified Weed Free Forage, by a manufacturer whose principle business is wattle manufacturing. The netting shall consist of seamless, high-density polyethylene and ethyl vinyl acetate and contain ultra violet inhibitors.

The Wattle shall meet the minimum performance requirements of Table 1. The product must be guaranteed to meet all numeric performance values in Table 1 under the specific conditions as stated.

**TABLE 32.10 A – TEMPORARY EROSION CONTROL
AND SEDIMENT RETENTION WATTLE**

Property	Test Method	Units	Min. Value
Mass per Unit Weight	Field Measured	(lbs/ft)	1.6
Dimension	Field Measured	(Dia/Inches)	8.0 - 9.0
Net Strand Thickness	Field Measured	(Inches)	0.030
Net Knot Thickness	Field Measured	(Inches)	0.055
Netting Unit Weight	Certified	(Ounces/ft)	0.35
Installed Free- Board Ht.	Field Measured	(Height/Inches)	6.0 - 7.0
Straw Fiber	Field Measured	Avg. Length (in)	3.0
Fiber Content	Certified	% Straw	100

C. PREPARATION

Proper site preparation is essential to ensure complete contact of the sediment retention device (Wattle) with the soil. The slope should be prepared to receive the surface mulching/re-vegetation treatment prior to installation of the erosion control and sediment Retention Wattles. Remove all rocks, clods, vegetation or other obstructions so that the installed Wattles will have direct contact with the soil.

A small trench 2" - 3" in depth should be excavated on the slope contour and perpendicular to water flow. Soil from the excavation should be placed down-slope next to the trench.

D. INSTALLATION

Install the Wattles in the trench, insuring that no gaps exist between the soil and the bottom of the Wattle. The ends of adjacent Wattles should be tightly abutted so that no opening exists for water or sediment to pass through. Alternately, Wattles may be lapped, 6" minimum to prevent sediment passing through the field joint.

Wooden stakes should be used to fasten the Wattles to the soil. When conditions warrant, a straight metal bar can be used to drive a pilot hole-through the Wattle and into the soil.

32.10 BIODEGRADABLE LOG (WATTLE) DITCH CHECK (Continued)

D. INSTALLATION (Continued)

Wooden stakes should be placed 6" from the Wattle end angled towards the adjacent Wattle and spaced at 2' leaving less than 1"- 2" of stake exposed above the Wattle. Alternately, stakes may be placed on each side of the Wattle tying across with a natural fiber twine or staking in a crossing manner ensuring direct soil contact at all times.

Terminal ends of wattles may be dog legged up slope to ensure containment and prevent channeling of sedimentation.

Backfill the upslope length of the Wattle with the excavated soil and compact.

Care shall be taken during installation so as to avoid damage occurring to the Wattle as a result of the installation process. Should the Wattle be damaged during installation, a wooden stake shall be placed either side of the damaged area terminating the log segment.

Field monitoring shall be performed to verify that the placement does not damage the Wattle. Any Wattle damaged during placement shall be replaced as directed by the City's Project Manager, at the Contractor's expense.

E. MAINTENANCE AND REMOVAL

The Wattles shall be inspected after installation to ensure that they are trenched-in and that no gaps exist under the wattles or between adjacent ends of the wattles.

Sediment deposits that impair the filtration capability of the wattle shall be removed when the sediment reaches one-third of the wattle's functional freeboard height. Removed sediment shall be deposited within the project in such a way that the sediment is not subject to erosion by wind or water, or as directed by the City's Project Manager.

Installed Wattles shall be removed and-or replaced as required to adapt to changing conditions.

When no longer required for the intended purpose, as determined by the City's Project Manager, temporary wattles shall be removed from the site. As an option, the straw wattles may be slit down the length of the netting, and the straw may be used on-site as directed by the City's Project Manager. The netting and stakes shall be gathered and disposed of in regular means as it is non-hazardous, inert material.

Trenches, depressions or any other ground disturbances caused by the removal of the temporary straw wattles shall be backfilled and repaired with the excess sediment captured by the wattle, prior to spreading the straw or other final erosion control protection.

F. BASIS OF PAYMENT

Installation shall be paid for at the contract unit price per linear foot (LF) for BIODEGRADABLE LOG DITCH CHECK INST. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the Work.

32.10 BIODEGRADABLE LOG (WATTLE) DITCH CHECK (Continued)

F. BASIS OF PAYMENT (Continued)

Maintenance shall be paid for at the contract unit price bid per linear foot (LF) for BIODEGRADABLE LOG DITCH CHECK MAINT. This price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in these Standard Specifications.

Removal shall be paid for at the contract unit price bid per linear foot (LF) for BIODEGRADABLE LOG DITCH CHECK REM. This price shall be full compensation for removal, disposal of structures and any trapped sediment, cleaning the site, and any and all labor, tools, equipment, and incidentals necessary to complete the Work.

32.11 COIR FIBER LOG REVETMENTS

A. GENERAL

Coir Fiber Logs are installed along the toe of the streambank in order to effectively manage changes in stream flow velocity, providing channel stabilization until vegetation has established. Coir fiber logs are biodegradable and once installed, will remain in place until they decompose.

B. MATERIALS

1. Coir Fiber Logs shall be BioLog, BioD-Roll or approved equal. Coir Fiber Logs shall be made of 100 percent coconut (coir) fiber fill and bound by high strength coir netting with outer net openings of 2" x 2". Logs shall be 12" in diameter with an average weight of 5 lbs/ft and density of 7 lbs/cubic foot.
2. Wood Stakes shall be a minimum of 2" x 2" x 36" long non-treated hard wood.

C. INSTALLATION

Coir Fiber Logs shall be installed along the toe of the streambank, trenched in 3" and staked at 2' on center or as per the manufactures recommended installation, whichever is more stringent.

When used in conjunction with an erosion control blanket or turf reinforcement mat, the blanket or mat shall be installed under the coir log, within the 3" trench and staked into place with the installation of the coir logs. The remaining portion of the blanket or mat shall be installed and stapled per plans or Standard Specifications

D. MAINTENANCE

If, during required inspections, erosion and undermining beneath the log is observed, the log shall be pulled up and any lost soil shall be replaced and the log shall be reinstalled.

32.11 COIR FIBER LOG REVETMENTS (Continued)

E. BASIS OF PAYMENT

Coir Fiber Logs, constructed in conformance with the plans and these Standard Specifications and accepted by the City's Project Manager, shall be measured and paid for at the contract unit price bid per linear foot for COIR FIBER LOG. Measurement shall not include overlapping sections. Such payment shall be full compensation for all coir logs, wood stakes, excavation, slope preparation, fine grading, equipment, materials, tools, labor, and incidentals necessary to complete the Work.

Maintenance shall be paid for at the contract unit price bid per linear foot (LF) for COIR FIBER LOG MAINT. This price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in these Standard Specifications.

32.12 SWPPP SIGN

A. GENERAL

The permittee shall conspicuously post and maintain a notice about the permit and SWPPP near the main entrance of the site prior to engaging in any construction activity. The sign must be maintained and remain in place throughout the duration of the project until a Notice of Termination approval has been obtained.

The sign must include the following information:

- The project's permit number;
- The name and phone number of a local contact;
- A brief description of the project; and
- The location of the SWPPP, if not kept on site.

B. MATERIALS

The sign shall be constructed of a rigid material, such as plywood or outdoor sign board. Sign must be constructed in such a manner as to protect documents from damage due to weather (wind, sun, moisture, etc.).

C. INSTALLATION

The sign must be located near the entrance of the site such that it is accessible/viewable by the general public, but not obstructing views as to cause a safety hazard. If there is a perimeter fence or adjacent work trailer, it is acceptable to mount the sign on these permanent structures as long as they are visible from the construction site entrance.

D. MAINTENANCE

The information relative to the site shall be updated (i.e. contact information, location of SWPPP documents, etc.) and the sign shall be kept in good condition throughout the life of the project or until a Notice of Termination has been approved.

32.12 SWPPP SIGN (Continued)

E. BASIS OF PAYMENT

Payment for the installation of the SWPPP Sign shall be paid for at the contract unit price per each (EA), per occurrence for SWPPP SIGN INST. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for the maintenance of the SWPPP Sign shall be paid for at the contract unit price bid per each (EA), per occurrence for SWPPP SIGN MAINT. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the maintenance activities listed above.

Payment for the removal of the SWPPP Sign shall be paid for at the contract unit price bid per each (EA), per occurrence for SWPPP SIGN REM. This price shall be full compensation for any and all labor, tools, equipment and incidentals necessary to complete the removal activities listed above.

CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 33

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CHAPTER 33

IRRIGATION WORK

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CHAPTER 33

IRRIGATION WORK

33.00 DESCRIPTION

The Work described in this section shall pertain to any irrigation system. Work shall include all labor, material and equipment as well as obtaining all tap fees, permits as may be required to complete the irrigation system as herein specified. The Work shall comply with the requirements of all legally constituted authorities having jurisdiction.

Irrigation materials shall mean pipe, irrigation heads, valves, valve boxes, controller, wiring, backflow device, quick coupler valves, protective covers and all description required to be furnished for the project, in conformance with Lincoln Standard Plans, Special Provisions, and these Standard Specifications.

This Work shall consist of furnishing, delivering and installation of all irrigation material and all operations incidental thereto, in conformance with these Standard Specifications and the Special Provisions, including the following:

1. The regulation and adjustment of all sprinkler heads, timed sequence control devices, sectional valves, rain sensor, etc.
2. The provision of a qualified, sprinkler system technician to instruct the City's operating personnel in the maintenance and operation of the irrigation system.
3. Arrange for, obtain, and pay for all necessary permits, bonds, and fees.
4. Excavating and backfill and compaction for all Work as specified, and is to include all machinery and labor.
5. To complete underground irrigation system from the point of connection, throughout the site, including piping, fittings, valves, drains, sprinkler fittings, sprinkler heads, automatic controller(s) and any other necessary appurtenances.
6. To furnish and install all piping, fittings, valves, valve boxes, valve covers, electric valve wiring and appurtenances.
7. To furnish and install all automatic control devices and connect controller to electric service.
8. To test the entire piping and wiring systems.
9. To furnish and install sprinkler heads.
10. To regulate and adjust all sprinkler heads, timed sequence control devices, sectional valves, rain sensor, etc.

33.01 QUALITY ASSURANCE

A. MANUFACTURER'S QUALIFICATIONS

Provide underground irrigation system as a complete unit, including heads, valves, controls and accessories.

B. MATERIALS

Equipment and methods of installation shall comply with the following codes and standards:

- National Fire Protection Association (NFPA); National Electrical Code
- American Society for Testing and Materials (ASTM)
- National Sanitation Foundation (NSF)
- The Irrigation Association (IA)

C. GENERAL IRRIGATION REQUIREMENTS

Work shall be performed in conformance with the best standard of practice relating to the various trades and under the continuous supervision of an experienced irrigation capable of designing, electronically drawing, and interpretation of Standard Specifications appropriate for the project.

The Contractor shall coordinate the Work of this section with site earthwork, plumbing, electrical, concrete Work and other trades and schedule in a manner to avoid damage to other Work.

D. EXPLANATION OF DESIGN AND PLANS

It is intended that the Design represented by the Plans and Specifications specify an efficient and complete irrigation system for use in conformance with the Manufacturer's recommendations and meeting the City's Project Manager's approval.

The Irrigation Designer/Contractor shall verify the authenticity of all finish grades within the project area of insurance of proper coverage of the sprinkler system. All finish grades shall be approved in writing prior to installation of the irrigation system. Contractor shall further verify the onsite water pressure. System design is based upon static pressure at the point of connection of each tap with a minimum operating pressure at the irrigation head of 25 psi.

E. SUBMITTALS

Submit manufacturer's product data and installation instructions for each of the system components.

Submit shop drawings for underground irrigation system, including plan layout and details illustrating location and type of heads, valves, piping circuits, controls and accessories. Submit technical data supporting layout design, including individual circuit (section) GPM and pressure loss calculations.

33.01 QUALITY ASSURANCE (Continued)

F. PERMITS AND INSPECTIONS

All Work shall comply in every respect with all city, county and state requirements, laws, ordinances, and rules.

The irrigation Contractor shall obtain and pay for all licenses, permits, and inspections as required by law for the Work specified herein and the accompanying plans.

This will include backflow prevention equipment with shutoff valves and unions for removal.

G. FIELD RECORD DRAWINGS

Upon completion of the irrigation system, a complete “record drawing” will be submitted to the City’s Project Manager. This drawing shall include a hard copy or an electronic file compatible with the City’s CAD system and shall indicate thereon all pipe sizes, valve locations, dimensional data from building walls or column center lines, to the piping and valves, sprinkler heads, etc. Accompanying the record drawings shall be instruction sheets and parts lists, covering all operating equipment, bound into a folder.

H. SITE CHECK

Contractor shall carefully examine the Work site, local conditions, Standard Specifications and plot plan for any existing utilities. Any damage to existing utilities or existing structures shall be repaired by the Contractor at no cost to the City.

I. DELIVERY, STORAGE AND HANDLING

Deliver irrigation system components in manufacturer’s original undamaged and unopened containers with labels intact and legible.

Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded and unthreaded.

Store and handle materials to prevent damage and deterioration.

Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced to prevent installation delays.

33.02 MATERIALS

A. ACCEPTABLE MANUFACTURERS

Many of the materials chosen for the design of the sprinkler system, have been specifically referred to by the manufacturer’s name so as to enable the City to continue to install similar equipment as utilized on previous projects in the project area. Acceptable manufacturers include:

Rain Bird

Or equal, if and specifically listed and approved by special provision or addendum during the bidding period.

33.02 MATERIALS (Continued)

B. COPPER PIPING

Copper piping shall be Type K, hard copper, and will be used on all exposed pipe, i.e. back flow preventer, etc.

Copper pipe fittings shall be wrought solder-type cast solder-joint fittings.

C. PVC PIPE

All PVC pipe shall be virgin, high impact, polyvinyl chloride having a minimum working pressure rating of Class 200 or Schedule 40. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, material size, and schedule of type. Pipe shall conform to U.S. Department of Commerce Commercial Standard CS 207-60, or latest revision. Material shall conform to all requirements of PVC 1120, ASTM D-1785, or latest revision.

Priming and solvent welding shall cause complete leak proof plasticized joint upon evaporation. Solvent shall conform to U.S. Government Specification No. GS-256.63.

D. POLYETHYLENE PIPE

ASTM 2239 flexible polyethylene pipe rated at 100 psi minimum working pressure.

E. SPRINKLER RISER

Flexible swing pipe on heads using 3 gal. /min. or less pvc schedule 40 unitized swing joint on head using more than 3 gal. /min.

F. GATE VALVES

Manufacturer's standard of type and size required brass construction conforming to A.W.W.A. Specifications.

G. DRAIN VALVES

Manufacturer's standard of type and size required.

1/2" Model AFD-0500 antifreeze drain valve manufactured by Kbi or equal, if and as specifically listed and approved by special provision or addendum during the bidding period.

H. REMOTE CONTROL VALVES

Manufacturer's standard of type and size required.

All valves will be located in valve boxes 12" minimum, plastic construction as manufactured by Amtek Corp. Valve box shall be vandal resistant. Lift off lids are not acceptable.

33.02 MATERIALS (Continued)

I. BACKFLOW PREVENTER

The backflow preventer shall be of brass construction conforming to City of Lincoln Standard Requirements for turf irrigation systems. Building and Safety recognize 2 devices appropriate for irrigation systems:

- Reduced Pressure (RP) principle backflow preventer
- Pressurized Vacuum Breaker (PVB)

The PVB must be installed a minimum of 12" above the highest sprinkler head or outlet on the system.

J. WIRING

Electric control wires from each controller to the automatic valves shall be direct burial UF wire of a different color than the black and white wires used on the 115-volt A.C. power. Ground wire shall be a different color than the control lines. A ground wire shall be required for each controller.

All wire shall be spliced only at valve locations. Minimum size shall be 14-gauge, solid single conductor, copper.

Provide 10" expansion coil at each valve and at 100 ft. intervals.

K. AUTOMATIC CONTROLLERS

Automatic controller shall be a Rainbird ESP LXM or approved equal, pedestal mounted. Controller shall be located in a metal, weather proof and locking housing and shall be installed adjacent to the back-flow device. Electrical power (120v, 5a) supply and hook-up to the automatic irrigation controller shall be provided by the owner at the location shown on the irrigation plan.

The controller to be installed and wired in conformance with the manufacturer's published instructions.

Construction: Controller shall be enclosed in a structure having a hinged cover with provision for locking. Controller shall be completely electric in operation and shall not employ hydraulic tubing, or otherwise introduce into the controller water or other fluids subject to freezing or leakage.

Location of controller is indicated on Plans.

L. SHRUB AND LAWN SPRINKLER HEADS

All full and part circle sprinkler bodies and nozzles. These sprinklers shall be of the pop-up type. Spacing of the heads shall not exceed the manufacturer's maximum recommendations.

Matched precipitation will be required on all full and part circle sprinklers on the same zone.

M. REMOTE CONTROL VALVES

Manufacturer's standard of type and size required.

33.02 MATERIALS (Continued)

N. WIRELESS VALVE SYSTEM

Must include a fully submersible battery-powered control unit, waterproof and able to perform system checks, up to 100' away without direct access to the control, solenoid design for minimal power consumption, full submersible and waterproof to 12', ability to set each valve up with own start time, run time and day schedule, double-sealed battery compartment and weather sensor compatible.

O. AUTOMATIC VALVES

Remote control valves shall be solenoid operated, diaphragm, globe-type having IPS threads and suitable for underground burial without protection.

Construction: Valve shall be packless, without sliding seals, and completely serviceable without removing body from pipeline. Design shall be normally closed requiring solenoid to be energized to open valve, thereby causing automatic closure in event of power failure. Solenoid shall comply with Class 2 National Electric Code and when operating require a maximum of 3.0 watts 24 volts AC. Solenoid shall be coated in epoxy to form a corrosion and moisture proof unit with exposed metal components of non-corrosive material.

P. VALVE BOXES

New control valves shall be installed in 12" standard valve box. All valve boxes shall be as manufactured by Ametek, Caroson or approved equal. Valve boxes shall be installed on a minimum of 1 cubic foot base of washed gravel for proper foundation of box and easy leveling of box to proper grade and also to provide proper drainage of the valve box. Lift off lids are not acceptable.

Q. IRRIGATION CONTROL WIRING

All new wiring to be used for connecting the automatic controller to the electric remote-control valves shall be type UF600V, #14, single wire direct burial PE irrigation control cable. It shall be UL listed and have a 4/64" covering of I.C.C. 100 compound insulation. All pilot or "hot" wires are to be of one color and all "common" wires are to be another color. The Contractor is to install two wires of another color in conjunction with the common wire. These extra wires will be used in the case of wire failure. The additional wires shall be a different color than the control and common wires. All wire connections shall be made with 3M DBY connectors.

R. COPPER TRACER WIRE

Copper tracer wire should be installed with all piping so that the system made is easily found for purposes of adjustments, repairs, and replacements.

S. BACKFLOW DEVICE

The backflow preventer shall be a Febco 765 or approved equal (size as on drawing) pressure type backflow. Size and location shall be per the Irrigation Plan and details or approved equal.

33.02 MATERIALS (Continued)

T. RAIN SHUT-OFF

A rain sensing device shall be installed which will override the automatic setting in the event of rain. This device shall be a "Rain Check", manufactured by Rainbird or equivalent. The device shall be mounted in a location unobstructed by walls, trees, or other hindrances, and shall be located so as not to be vandalized. Contractor shall verify the location and routing or control wires with the City's Project Manager prior to installation.

U. QUICK COUPLER VALVES

All quick couplers shall be of 5RC body, 55K key and an SH1 swivel 1" shaft x 1" MPT x 3/4" hose thread. Quick coupling valves shall be located within a weather resistant plastic valve box 6" minimum, with lockable lid. Do not locate within paved surfaces. Top of quick coupler valves shall be as close to the top of valve box as possible, with a means to anchor coupler valve to prevent it from unthreading from the riser.

A 4" deep layer of coarse gravel shall be placed within the valve box beneath the bottom of the valve.

Backfill shall consist of clean soil free from stones larger than 1" diameter, foreign matter, organic matter and debris. Suitable excavated materials removed to accommodate the irrigation system Work may be used as fill. Imported fill material may be used as required to complete the Work. The Contractor shall obtain rights and pay all costs for imported materials.

Drainage backfill shall be clean gravel or crushed stone, graded from 3/4" minimum to 3" maximum.

Copper Wire installed shall be: #12 awg copper wire with National Electrical Code type THHN/THWN insulation.

V. BACKFLOW ENCLOSURE

The backflow device shall have a steel locking vandalism resistant enclosure approved by the City's Project Manager.

33.03 SYSTEM DESIGN

System Design should not begin until all existing conditions are satisfactorily understood

A. DESIGN PRESSURES

Determine from the City of Lincoln Public Works Department. Actual working pressure in an individual circuit shall fall between manufacturer's recommended minimum and maximum operating pressures for the last sprinkler head in the circuit.

B. DESIGN VELOCITIES

Velocity of water in sprinkler system should not exceed 5 - 6 fps.

33.03 SYSTEM DESIGN (Continued)

C. LOCATION OF SPRINKLER HEADS

Except for street medians, begin sprinkler head location at areas to be bordered (sidewalks, etc.) Fill in with sprinklers in the middle areas. Design for 100% radius overlap coverage. Locate sprinkler heads based on triangular spacing wherever possible. Locate sprinkler heads so that trees are approximately halfway between heads wherever possible. Do not overspray sidewalks, streets, or pavements.

D. SECTIONING OF IRRIGATION SYSTEM

Individual circuits shall be designed so that total gallons per minute (GPM) required per circuit does not exceed available GPM. System shall be designed so that areas irrigated by individual circuits exhibit compatible conditions, including soil type, plant material type and sun exposure. System shall be designed so that sprinkler head types and precipitation rates of sprinklers are compatible on same circuit. Design system so that circuits furthest from supply require lowest total GPM. Design system so that each section includes one quick coupling valve.

E. PIPING

Piping should be laid out as to avoid sides of structures, odd angles, unbalanced friction losses, high friction losses, and excessive trenching.

F. EXCAVATING AND BACKFILLING

An excavation shall be considered unclassified excavation and include all materials encountered.

Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings.

If the pulling method is used, the pipe "plow" shall be a vibratory type. Starting and finishing holes for pipe pulling shall not exceed 1'-0 by 3'-0" opening.

Excavate to depths required to provide 2" depth of earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.

Fill to match adjacent grade elevations with approved earth fill materials. Place and compact fill in layers not greater than 6" DEPTH. Provide approved earth fill or sand to a point 4" above the top of pipe. Fill to within 6" of final grade with approved excavated or borrow fill materials free of lumps or rocks larger than 1" any dimension. Provide clean topsoil free of rocks and debris for top 6" of fill. Install irrigation lines with a minimum cover of 24" for main lines. 12" for laterals based on existing finished grade.

Excavate trenches and install piping and fill during the same working day. Do not leave trenches or partially filled trenches open overnight.

33.04 INSTALLATION

A. INSTALLATION SCHEDULE AND IMPLEMENTATION

The irrigation Work shall be scheduled by the Irrigation Contractor in such a way that existing underground utilities are protected.

The location of each run of pipe, mainline or laterals, and all irrigation head and valves, shall be staked out by the Irrigation Contractor prior to trenching. All pipe, valves, fittings, etc. shall be carefully placed in the locations as shown on the plans and details. The interior of pipes shall be kept free from dirt and debris and when pipe laying is not in progress, open ends of pipes shall be closed by approved means.

B. INSPECTION

When the Irrigation Contractor is prepared for one of the required inspections, the Contractor shall give the City's Project Manager adequate notice to visit the site and perform the inspection. This does not preclude the right of the City's Project Manager to make informal inspection at any time during the Work of this section. The required inspections for which the Irrigation Contractor must notify the City's Project Manager are as follows:

1. UTILITY AND IRRIGATION EQUIPMENT LOCATION STAKING

The City's Project Manager shall inspect the proposed locations of all Irrigation lines and heads for conformance to the Plans and Specifications. The City's Project Manager reserves the right to move, shift or adjust any or all of the proposed locations to better achieve the design intentions as shown on the plans.

2. WIRING INSPECTION

When the wiring has been installed, City's Project Manager shall inspect for conformance to these Plans and Specifications.

3. COVERAGE TEST

After the sprinkler heads have been installed and backfilling operations are complete, the Irrigation Contractor, in the presence of the City's Project Manager, shall perform a coverage test to determine if the irrigation system reaches all parts of the areas to be sodded.

4. STAKING AND LAYOUT

The Irrigation Contractor shall provide all materials necessary for the staking of the irrigation system. All irrigation heads are to be flagged for the City's Project Manager's observation. Contact the City's Project Manager, in advance, and request inspection of the layout. The City's Project Manager will observe layout and indicate any changes as needed.

33.04 INSTALLATION (Continued)

C. TRENCHING/HORIZONTAL BORING

Trenches shall be excavated straight and true with the bottom of the trench uniformly sloped to low points.

Minimum cover over top of installed piping shall be:

- Mainline - 18" minimum
- Lateral Lines - 12" minimum
- Piping under pavement - 24" minimum
- Sleeves - 18" minimum

Trenches shall be backfilled with clean material from excavation. Remove organic material as well as rocks and debris larger than 1" diameter. Place acceptable backfill material in 6" lifts, compacting each lift and flush with water to settle trench except for pavement. The site shall be continuously cleaned up of excess and/or waste materials as the backfilling progresses and shall be left in a neat and workmanlike condition.

Where trenching is required across existing lawns, cut sod uniformly in strips 6" wider than the trench. Remove sod in rolls of suitable size for handling and keep moistened until replanted or replaced.

Backfill trench to within 6" of finished grade and continue fill with acceptable topsoil, compacting the fill to bring sod even with the existing lawn.

Replant sod within 7 days after removal, roll and water generously.

Reseed and restore to original conditions any sod areas not in healthy condition equal to adjoining lawns 30 days after replanting.

D. BACKFLOW PREVENTER

Install backflow prevention valve, pump, booster pump, fittings and accessories required to complete the system. Provide union on downstream and upstream side. Install minimum 12" above highest ground level sprinkler head.

E. CIRCUIT VALVES

Install in conformance to the manufacturer's instructions. Install in valve box, arranged for easy adjustment and removal. Install valve access boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the access box. Provide union on downstream and upstream side. Seal threaded connections on pressure side of control valves with Teflon tape or plastic joint type compound. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

33.04 INSTALLATION (Continued)

F. PLASTIC PIPELINE FITTINGS

1. INSTALLATION

All workmanship and materials shall be in conjunction with all applicable local codes and ordinances of legally constituted authorities; where the provisions of these Standard Specifications exceed such requirements, these Standard Specifications shall govern. All plastic pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the Manufacturer.

2. SOLVENT-WELD PIPE AND FITTINGS

Install pipe in dry weather when temperature is above 40° F and in conformance with manufacturer's installation directions. Provide for thermal expansion and contraction. Solvent-weld plastic pipe shall be cut with a pipe cutter or fine-tooth hacksaw with the assistance of a square-in sawing device or in a manner so as to assure a square cut. Burrs and cut ends shall be removed prior to installations so that smooth, unobstructed flow will be obtained. Only the solvent recommended by the manufacturer shall be used. The solvent-weld joints shall be made in the following manner:

Thoroughly clean the mating pipe and fitting with a clean dry cloth. Use primer on connections prior to solvent welding.

Apply a uniform coat of solvent to the outside of the pipe with a nonsynthetic bristle brush. Apply solvent to the fitting in a similar manner. Re-apply a light coat of solvent to the pipe and quickly in-set it into the fitting.

Give the pipe or fitting a 1/4 turn to insure even distribution of solvent and make sure the pipe is inserted to the full depth of the fitting socket. Hold in position for 30 seconds. Wipe off excess solvent that appears at the outer shoulder of the fitting. Care should be taken so as not to use an excessive amount of solvent, thereby causes a weakening or obstruction on the inside of the pipe. The joints in the PVC pipe shall be allowed to set at least 24 hours before pressure is applied to the system at a temperature above 40° F.

The pipe shall be installed and maintained at the proper lines and grades with joints centered and with fittings and other appurtenances at the required locations.

All risers to heads shall be constructed of nipples or elbows to permit height adjustment of head. Install heads 2" back of any hard surface.

3. LINES UNDER PAVEMENT

Provide sleeves (as required) using PVCE pipe sized under walks and paving. Location and depths of sleeves shall be noted on the As-Built Irrigation Plan. All sleeving shall be twice the diameter of the irrigation pipe.

33.04 INSTALLATION (Continued)

G. CONTROL AND COMMON WIRE INSTALLATION

Control, common and extra wires shall be installed beside the mainline and in sleeves where required. Wire shall then be placed as loose as possible to allow for expansion and contraction of the wire. Verification of the wire types and installation procedure should be checked to conform to local codes. Connecting and splicing of wire at the valve or in the field will be made by using DBY wire connectors (as designated by the Details). The Irrigation Contractor shall isolate field splices in 1 central location, in a valve box, if possible. All field splices shall be installed in an Ametek or Carson valve box.

H. AUTOMATIC CONTROLLER

The Automatic Controller and protective enclosures shall be installed adjacent to the backflow device when possible. Alternative locations must be discussed with City's Project Manager. Install box guard shack or equal enclosure per manufacturer's Specifications.

I. CONTROL VALVES

Connect each remote-control valve to one station of a controller. Connect remote control valves to a common ground wire system independent of other controllers. Make wire connections to remote control electric valves and splices of wire in the field, using DBY wire connectors in conformance with manufacturer's recommendation.

J. VALVE BOXES

Control valve boxes shall be installed on a minimum of 1 cubic foot base of clean gravel for proper foundation of box and easy leveling of box to proper grade and also to provide drainage of the valve box.

K. DRAINAGE

Drainage pits shall consist of 2 cubic foot well, filled to capacity with crushed stone. Drain locations shall be determined on job site by the irrigation Contractor. Provide drains at all low points on the branch piping and in the main at intervals not to exceed 200' of pipe.

L. SPRINKLER HEADS

Unless otherwise specifically designated on the Plans, the installation of irrigation heads shall include the excavation and backfill, furnishing, installing and testing of risers, fittings and irrigation heads in conformance with the Plans and Specifications. All irrigation heads shall be installed with pipe or swing joint assemblies as per details.

M. FLUSHING AND TESTING

After all new irrigation piping is in place and connected for a given section, and all necessary division Work has been completed, prior to the installation of the pop-up nozzles, all control valves shall be opened and a full head of water used to flush out the system. Pressure test all lines before join areas are backfilled. Backfill a portion of the trench are to maintain pipe stability during test period. All mainline piping shall be tested at hydraulic pressure of 100 PSI. Upon visual inspection of each joint and the ground, any leak detected shall be repaired. The line shall be re-tested until the necessary repairs made to the system are in good working order. After testing, the system shall be flushed with the operation flow passing through each pipe, beginning with the larger mains and continuing through the smaller mains in sequence.

33.04 INSTALLATION (Continued)

N. ADJUSTMENTS

Upon completion of the performance system testing, all necessary repairs and adjustments shall be made.

Adjust sprinklers after installation for proper and adequate distribution of the water over coverage pattern. Adjust for the proper arc of coverage.

The irrigation Contractor and their assignees shall continue to be responsible for properly making any additional adjustments during the maintenance period.

Tighten nozzles on spray type sprinklers after installation. Adjust heads to achieve required coverage and precipitation rates.

Adjust all electric remote-control valve pressure regulators and flow control stems for system balance and optimum performance.

Test and demonstrate the controller by operating appropriate day, hour and station selected features as required to automatically start and shut down irrigation cycles to accommodate plant requirements and weather conditions.

33.05 PROTECTION AND REPAIRS

It shall be the responsibility of the Irrigation Contractor to protect and preserve any existing structures, concrete walls, etc. from damage during irrigation construction. If damage does occur, all damage shall be completely repaired or restored by the Irrigation Contractor at no additional cost to the project.

33.06 CLEAN UP

Perform clean up as a continuous operation throughout the duration of the Work. Remove from site all excess materials, soil, debris and equipment. Repair damage resulting from irrigation system installation.

Protect irrigation system and materials from damage due to performance of Work, operation by other Contractors, trades and trespassers. Maintain protection during installation and testing periods.

The entire site shall be left clean, neat and free of debris.

The Contractor shall be responsible for all damage caused by operations to trees, shrubs, curbs, paving, structures, utilities, etc. on the site or adjacent to the site of Work and shall repair, replace or otherwise make good any damage caused by Work.

33.07 FINAL INSPECTION

When the Irrigation Contractor is satisfied that the system is operating properly, that it is balanced and adjusted, and that all Work and clean up is completed, the Contractor shall notify the City's Project Manager that the Work is prepared for Final Inspection. At the given time, the sprinkler system will be inspected for the following:

- Sprinkler heads adjusted to grade
- Sprinkler heads properly aligned
- Nozzles properly adjusted
- Broken heads replaced
- Missing heads replaces (stolen or otherwise)
- Broken risers replaced
- Gate valves and control valves operation properly and not leaking
- Controller operating properly and programmed

Any inconsistencies to the Standard Specification will be noted by the City's Project Manager and a written copy of corrections will be given to the Irrigation Contractor. The City's Project Manager will not accept the system until the corrections from the final inspection have been made by the Irrigation Contractor and an "as built" drawing(s) in both hard copy and electronic format including plan layout and details illustrating location and type of heads, valves, piping circuits, controls and accessories shall be delivered to the City's Project Manager.

33.08 MAINTENANCE

The maintenance of the irrigation system once installed needs to include:

- A description of routine maintenance for 1 year must be developed. Spring start ups and winterization must be included as well as regular monthly check-ups throughout the season of operation.
- A schedule for 1 year of maintenance must be submitted for review by the City's Project Manager, agreed upon and followed by the Contractor.
- Maintenance responsibilities must be assigned to an appointed and qualified employee or outsourced to a private company which specializes in the maintenance and repair of irrigation systems.

33.09 OPERATION

The operation of the system is critical to delivering the correct amount of water required by the plant material.

The watering schedule must be created around the anticipated water requirements of the plant material. A watering schedule must be developed to assure plant material is receiving adequate water. The schedule should be developed in consultation with the City's Project Manager. The water schedule must be assigned to an appointed and qualified employee or outsourced to a private company.

33.10 REPLACEMENT AND GUARANTEE

The new irrigation system workmanship and materials shall be guaranteed for the period of 1 year from the date of acceptance of Work. The irrigation Contractor shall be responsible for proper winterization of the irrigation system during the 1-year guaranteed period. This shall include at least one winterization and one spring charge-up of the system.

Should any trouble develop within the time specified above due to faulty materials or material, the defect shall be corrected by the Irrigation Contractor without expense to the owner. The irrigation Contractor is not responsible for repair of sprinkler system due to vandalism, fire, theft acts beyond the Contractor's control.

33.11 QUALIFICATIONS FOR SUBMITTING BIDS

The installation of the irrigation system needs to be performed at a level which will insure the longevity of the system. It is recommended that the Contractor performing the Work must:

- Be a certified irrigation Contractor and fully insured and licensed.
- Be able to demonstrate a minimum work experience record.
- Have successfully completed projects similar in scope and scale.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

APPENDIX A

PAY ITEM LIST

Standard Item No.	Standard Item Description	Section	Unit
01.00001	Mobilization	GENERAL	LS
01.01001	Const Staking	GENERAL	LS
01.02001	Survey Monument and Box	GENERAL	EA
01.03001	Property Pin Establishment	GENERAL	EA
01.04001	Pavt & Sidewalk Rem	GENERAL	CY
01.05001	Sawing, Type "A"	GENERAL	LF
01.06001	Sawing, Type "B"	GENERAL	LF
01.07001	Sawing, Type "C"	GENERAL	LF
01.08001	Sawing, Type "D"	GENERAL	LF
01.09001	Wheel Sawing	GENERAL	LF
01.11001	Adj MH to Grade	GENERAL	EA
01.12001	Adj Inlet to Grade	GENERAL	EA
01.12002	Adj Grate Inlet to Grade	GENERAL	EA
01.13001	Adj Water Valve Box to Grade	GENERAL	EA
01.13002	Adj Water Stop Box to Grade	GENERAL	EA
02.01001	Gen Clearing & Grubbing	EARTHWORK	LS
02.02012	Tree Rem (12" to 23")	EARTHWORK	EA
02.02024	Tree Rem (24" to 35")	EARTHWORK	EA
02.02036	Tree Rem (36" & Over)	EARTHWORK	EA
02.02112	Stump Rem (12" to 23")	EARTHWORK	EA
02.02124	Stump Rem (24" to 35")	EARTHWORK	EA
02.02136	Stump Rem (36" & Over)	EARTHWORK	EA
02.03001	Transplant Tree (Saplings to 6")	EARTHWORK	EA
02.04001	Rem & Reset Fence	EARTHWORK	LF
02.05001	Excavation	EARTHWORK	CY
02.05002	Over-Excavation	EARTHWORK	CY
02.05003	Excavation - Borrow	EARTHWORK	CY
02.06001	Excavation - Disposal	EARTHWORK	CY
02.08001	Earthwork Measured in Embankment	EARTHWORK	CY
02.09001	Parking Space Finish	EARTHWORK	SY
02.10001	Subgrade Stabilization	EARTHWORK	SY
03.06001	Flowable Fill	PAVING	CY
04.09006	PCC Pavt, 6"	PAVING	SY
04.09007	PCC Pavt, 7"	PAVING	SY
04.09008	PCC Pavt, 8"	PAVING	SY
04.09009	PCC Pavt, 9"	PAVING	SY
04.09010	PCC Pavt, 10"	PAVING	SY
04.09106	PCC Pavt w/Int Curb, 6"	PAVING	SY
04.09107	PCC Pavt w/Int Curb, 7"	PAVING	SY
04.09108	PCC Pavt w/Int Curb, 8"	PAVING	SY
04.09109	PCC Pavt w/ Int Curb, 9"	PAVING	SY

Standard Item No.	Standard Item Description	Section	Unit
04.09110	PCC Pavt w/Int Curb, 10"	PAVING	SY
04.09206	RPCC Pavt, 6"	PAVING	SY
04.09207	RPCC Pavt, 7"	PAVING	SY
04.09208	RPCC Pavt, 8"	PAVING	SY
04.09209	RPCC Pavt, 9"	PAVING	SY
04.09210	RPCC Pavt, 10"	PAVING	SY
04.09304	Conc Sidewalk, 4"	PAVING	SF
04.09305	Conc Sidewalk, 5"	PAVING	SF
04.09306	Conc Sidewalk, 6"	PAVING	SF
04.09307	Conc Sidewalk, 7"	PAVING	SF
04.09308	Conc Sidewalk, 8"	PAVING	SF
04.09309	Conc Sidewalk, 9"	PAVING	SF
04.09310	Conc Sidewalk, 10"	PAVING	SF
04.09405	Conc Driveway, 5"	PAVING	SF
04.09406	Conc Driveway, 6"	PAVING	SF
04.09505	Conc Bikeway, 5"	PAVING	SF
04.09506	Conc Bikeway, 6"	PAVING	SF
04.09507	Conc Bikeway, 7"	PAVING	SF
04.09508	Conc Bikeway, 8"	PAVING	SF
04.09509	Conc Bikeway, 9"	PAVING	SF
04.09510	Conc Bikeway, 10"	PAVING	SF
04.09601	Combined Curb & Gutter	PAVING	LF
04.09602	Conc Barrier Curb (9" X 20")	PAVING	LF
04.09604	Conc Median Curb	PAVING	LF
04.09700	Remove Conc Header	PAVING	LF
04.09701	Install Conc Header	PAVING	LF
04.09800	Conc Median Nose	PAVING	EA
04.09804	Conc Median Surfacing, 4"	PAVING	SF
04.09806	Tack-on Conc Median, 6"	PAVING	SF
04.10006	PCC Alley Pavt, 6"	PAVING	SY
04.10007	PCC Alley Pavt, 7"	PAVING	SY
04.10008	PCC Alley Pavt, 8"	PAVING	SY
04.11001	Detectable Warning Panels	PAVING	SF
04.12001	Conc Pavt Repair, Ty A, Partial Depth, FPMC	PAVING	CY
04.12002	Conc Pavt Repair, Ty B, Partial Depth, FPMC	PAVING	CY
04.12301	Conc Pavt Repair, Ty A, Partial Depth Asphalt, Ty 3	PAVING	CY
04.12350	Conc Pavt Joint Repair, L3500, PCC	PAVING	CY
04.12351	Conc Pavt Repair, Ty A, Full Depth, L3500, PCC	PAVING	CY
04.12352	Conc Pavt Repair, Ty B, Full Depth, L3500, PCC	PAVING	CY
04.12353	Conc Pavt Repair, Ty C, Full Depth, L3500, PCC	PAVING	CY
04.12354	Conc Pavt Repair, Ty A, Partial Depth, L3500, PCC	PAVING	CY
04.12355	Conc Pavt Repair, Ty B, Partial Depth, L3500, PCC	PAVING	CY
04.12550	Conc Pavt Joint Repair, L5500, PCC	PAVING	CY
04.12551	Conc Pavt Repair, Ty A, Full Depth, L5500, PCC	PAVING	CY
04.12552	Conc Pavt Repair, Ty B, Full Depth, L5500, PCC	PAVING	CY
04.12553	Conc Pavt Repair, Ty C, Full Depth, L5500, PCC	PAVING	CY

Standard Item No.	Standard Item Description	Section	Unit
04.12554	Conc Pavt Repair, Ty A, Partial Depth, L5500, PCC	PAVING	CY
04.12555	Conc Pavt Repair, Ty B, Partial Depth, L5500, PCC	PAVING	CY
04.12701	Joint Sealing	PAVING	LF
04.12801	Crack Sealing	PAVING	LF
05.07000	Conc Base, LB-2750, 5"	PAVING	SY
05.07005	Conc Base, LB-3500, 5"	PAVING	SY
05.07006	Conc Base, LB-3500, 6"	PAVING	SY
05.07007	Conc Base, LB-3500, 7"	PAVING	SY
05.07008	Conc Base, LB-3500, 8"	PAVING	SY
06.04000	Surface Milling	PAVING	SY
06.04100	Non-Woven Pavt Overlay Fabric	PAVING	SY
06.04200	Asphaltic Concrete Curb	PAVING	LF
06.06001	Asphaltic Concrete, Type 1	PAVING	TON
06.06002	Asphaltic Concrete, Type 2	PAVING	TON
06.06003	Asphaltic Concrete, Type 3	PAVING	TON
06.06004	Asphaltic Concrete, Type 4	PAVING	TON
06.07001	Joint and Crack Sealing of Asphaltic Concrete	PAVING	LF
07.08010	Conc for Steps & Retaining Walls	PAVING	CY
07.08020	Reinf Stl for Steps & Retaining Walls	PAVING	LBS
07.08030	Modular Block Retaining Wall	PAVING	SF
07.08040	Handrails	PAVING	LF
08.02042	Chain Link Fence, 42"	PAVING	LF
08.02048	Chain Link Fence, 48"	PAVING	LF
08.02054	Chain Link Fence, 54"	PAVING	LF
08.02060	Chain Link Fence, 60"	PAVING	LF
08.02066	Chain Link Fence, 66"	PAVING	LF
08.02072	Chain Link Fence, 72"	PAVING	LF
08.03048	Pipe Railing Fence, 48"	PAVING	LF
09.03001	Crushed Rock Roadway Surfacing	PAVING	TON
09.03002	Gravel Surfacing	PAVING	TON
09.04001	Crushed Rock Bikeway Surfacing	PAVING	SF
13.01001	Remove Mkg, Line, < 8"	TRAFFIC PAVEMENT MARKING	LF
13.01002	Remove Mkg, Wide Line, > 8"	TRAFFIC PAVEMENT MARKING	LF
13.01003	Remove Mkg, Symbol	TRAFFIC PAVEMENT MARKING	EA
13.02001	Preformed Thermoplastic Mkg, Symbol	TRAFFIC PAVEMENT MARKING	EA
13.02002	Preformed Thermoplastic Mkg, RR Xing Assy.	TRAFFIC PAVEMENT MARKING	EA
13.02012	Preformed Thermoplastic Mkg, 12"	TRAFFIC PAVEMENT MARKING	LF
13.02018	Preformed Thermoplastic Mkg, 18"	TRAFFIC PAVEMENT MARKING	LF
13.02024	Preformed Thermoplastic Mkg, 24"	TRAFFIC PAVEMENT MARKING	LF
13.03004	Molten Thermoplastic Mkg, 4"	TRAFFIC PAVEMENT MARKING	LF
13.03006	Molten Thermoplastic Mkg, 6"	TRAFFIC PAVEMENT MARKING	LF
13.03008	Molten Thermoplastic Mkg, 8"	TRAFFIC PAVEMENT MARKING	LF
13.03012	Molten Thermoplastic Mkg, 12"	TRAFFIC PAVEMENT MARKING	LF
13.03018	Molten Thermoplastic Mkg, 18"	TRAFFIC PAVEMENT MARKING	LF
13.03024	Molten Thermoplastic Mkg, 24"	TRAFFIC PAVEMENT MARKING	LF
13.04001	Polyurea Mkg, Symbol	TRAFFIC PAVEMENT MARKING	EA

Standard Item No.	Standard Item Description	Section	Unit
13.04002	Polyurea Mkg, RR Xing Assy.	TRAFFIC PAVEMENT MARKING	EA
13.04004	Polyurea Mkg, 4"	TRAFFIC PAVEMENT MARKING	LF
13.04006	Polyurea Mkg, 6"	TRAFFIC PAVEMENT MARKING	LF
13.04008	Polyurea Mkg, 8"	TRAFFIC PAVEMENT MARKING	LF
13.04012	Polyurea Mkg, 12"	TRAFFIC PAVEMENT MARKING	LF
13.04018	Polyurea Mkg, 18"	TRAFFIC PAVEMENT MARKING	LF
13.04024	Polyurea Mkg, 24"	TRAFFIC PAVEMENT MARKING	LF
13.04101	Grooved Polyurea Mkg, Symbol	TRAFFIC PAVEMENT MARKING	EA
13.04102	Grooved Polyurea Mkg, RR Xing Assy.	TRAFFIC PAVEMENT MARKING	EA
13.04104	Grooved Polyurea Mkg, 4"	TRAFFIC PAVEMENT MARKING	LF
13.04106	Grooved Polyurea Mkg, 6"	TRAFFIC PAVEMENT MARKING	LF
13.04108	Grooved Polyurea Mkg, 8"	TRAFFIC PAVEMENT MARKING	LF
13.04112	Grooved Polyurea Mkg, 12"	TRAFFIC PAVEMENT MARKING	LF
13.04118	Grooved Polyurea Mkg, 18"	TRAFFIC PAVEMENT MARKING	LF
13.04124	Grooved Polyurea Mkg, 24"	TRAFFIC PAVEMENT MARKING	LF
13.05004	Paint Mkg, 4"	TRAFFIC PAVEMENT MARKING	LF
13.05006	Paint Mkg, 6"	TRAFFIC PAVEMENT MARKING	LF
13.05008	Paint Mkg, 8"	TRAFFIC PAVEMENT MARKING	LF
13.05012	Paint Mkg, 12"	TRAFFIC PAVEMENT MARKING	LF
13.05018	Paint Mkg, 18"	TRAFFIC PAVEMENT MARKING	LF
13.05024	Paint Mkg, 24"	TRAFFIC PAVEMENT MARKING	LF
13.06001	Flexible Raised Pavement Marker	TRAFFIC PAVEMENT MARKING	EA
13.06004	Temporary Mkg, Tape, 4"	TRAFFIC PAVEMENT MARKING	LF
13.06104	Temporary Mkg, Paint, 4"	TRAFFIC PAVEMENT MARKING	LF
13.06106	Temporary Mkg, Paint, 6"	TRAFFIC PAVEMENT MARKING	LF
13.06108	Temporary Mkg, Paint, 8"	TRAFFIC PAVEMENT MARKING	LF
13.06112	Temporary Mkg, Paint, 12"	TRAFFIC PAVEMENT MARKING	LF
13.06118	Temporary Mkg, Paint, 18"	TRAFFIC PAVEMENT MARKING	LF
13.06124	Temporary Mkg, Paint, 24"	TRAFFIC PAVEMENT MARKING	LF
14.01001	Tubular Marker	TRAFFIC SIGNS	EA
14.02001	Tubular Marker Anchor, Square	TRAFFIC SIGNS	EA
14.03001	Remove Traffic Sign Only	TRAFFIC SIGNS	EA
14.03002	Remove Traffic Sign and Post	TRAFFIC SIGNS	EA
14.03003	Sign < 4 Sq Ft	TRAFFIC SIGNS	EA
14.03004	Sign FYG, < 4 Sq Ft	TRAFFIC SIGNS	EA
14.03005	Sign 4 Sq Ft < 9 Sq Ft	TRAFFIC SIGNS	EA
14.03006	Sign FYG, 4 Sq Ft < 9 Sq Ft	TRAFFIC SIGNS	EA
14.03007	Sign 9 Sq Ft or >	TRAFFIC SIGNS	EA
14.03008	Sign FYG, 9 Sq Ft or >	TRAFFIC SIGNS	EA
14.04001	Sign Post 2" Square	TRAFFIC SIGNS	EA
14.05001	Sign Post Anchor, 2 1/4" Square	TRAFFIC SIGNS	EA
15.05001	Dynamic Message Sign	TRAFFIC CONTROL	DAY
15.09001	Traffic Control for Const	TRAFFIC CONTROL	LS
15.09110	Small Work Zone Sign	TRAFFIC CONTROL	DAY
15.09120	Medium Work Zone Sign	TRAFFIC CONTROL	DAY
15.09130	Large Work Zone Sign	TRAFFIC CONTROL	DAY

Standard Item No.	Standard Item Description	Section	Unit
15.09202	Type II Barricade	TRAFFIC CONTROL	DAY
15.09203	Type III Barricade	TRAFFIC CONTROL	DAY
15.09210	Flashing Arrow Panels	TRAFFIC CONTROL	DAY
15.09300	Flagging	TRAFFIC CONTROL	DAY
15.09400	Conc Protect Barrier	TRAFFIC CONTROL	LF
15.09410	Relocate Conc Protect Barrier	TRAFFIC CONTROL	LF
15.09500	Ex Pave Marking Rem	TRAFFIC CONTROL	LF
15.09504	Temp Pave Mkg, 4"	TRAFFIC CONTROL	LF
15.09508	Temp Pave Mkg, 8"	TRAFFIC CONTROL	LF
15.09512	Temp Pave Mkg, 12"	TRAFFIC CONTROL	LF
15.09516	Temp Pave Mkg, 16"	TRAFFIC CONTROL	LF
15.09524	Temp Pave Mkg, 24"	TRAFFIC CONTROL	LF
15.09600	Grabber Cone, 42"	TRAFFIC CONTROL	DAY
15.09610	Tubular Marker, 42"	TRAFFIC CONTROL	DAY
20.05001	Foundation Material	UTILITIES & STRUCTURES	CY
20.06106	Directional Drilling for 6" Water Main	WATER	LF
20.06108	Directional Drilling for 8" Water Main	WATER	LF
20.06110	Directional Drilling for 10" Water Main	WATER	LF
20.06112	Directional Drilling for 12" Water Main	WATER	LF
20.06116	Directional Drilling for 16" Water Main	WATER	LF
20.07001	Conc for Collars, Elbows, Plugs & Hdwls	STORM DRAINAGE	CY
20.07002	Reinf Steel for Collars, Elbows, Plugs & Hdwls	STORM DRAINAGE	LBS
20.08001	Conc for Plugs & Collars	WASTEWATER	CY
20.08002	Reinf Steel for Collars	WASTEWATER	LBS
20.09001	Conc for Thrust Blocks & Anchorages	WATER	CY
20.09002	Reinf Stl for Thrust Blks & Anchorages	WATER	LBS
21.03012	Rem Storm Drain Pipe, 12"	STORM DRAINAGE	LF
21.03015	Rem Storm Drain Pipe, 15"	STORM DRAINAGE	LF
21.03018	Rem Storm Drain Pipe, 18"	STORM DRAINAGE	LF
21.03021	Rem Storm Drain Pipe, 21"	STORM DRAINAGE	LF
21.03024	Rem Storm Drain Pipe, 24"	STORM DRAINAGE	LF
21.03030	Rem Storm Drain Pipe, 30"	STORM DRAINAGE	LF
21.03036	Rem Storm Drain Pipe, 36"	STORM DRAINAGE	LF
21.03042	Rem Storm Drain Pipe, 42"	STORM DRAINAGE	LF
21.03048	Rem Storm Drain Pipe, 48"	STORM DRAINAGE	LF
21.03054	Rem Storm Drain Pipe, 54"	STORM DRAINAGE	LF
21.03060	Rem Storm Drain Pipe, 60"	STORM DRAINAGE	LF
21.03066	Rem Storm Drain Pipe, 66"	STORM DRAINAGE	LF
21.03072	Rem Storm Drain Pipe, 72"	STORM DRAINAGE	LF
21.03115	Rem and Relay RCP Storm Drain, 15"	STORM DRAINAGE	LF
21.03118	Rem and Relay RCP Storm Drain, 18"	STORM DRAINAGE	LF
21.03121	Rem and Relay RCP Storm Drain, 21"	STORM DRAINAGE	LF
21.03124	Rem and Relay RCP Storm Drain, 24"	STORM DRAINAGE	LF
21.03130	Rem and Relay RCP Storm Drain, 30"	STORM DRAINAGE	LF
21.03136	Rem and Relay RCP Storm Drain, 36"	STORM DRAINAGE	LF
21.03142	Rem and Relay RCP Storm Drain, 42"	STORM DRAINAGE	LF

Standard Item No.	Standard Item Description	Section	Unit
21.03148	Rem and Relay RCP Storm Drain, 48"	STORM DRAINAGE	LF
21.03154	Rem and Relay RCP Storm Drain, 54"	STORM DRAINAGE	LF
21.03160	Rem and Relay RCP Storm Drain, 60"	STORM DRAINAGE	LF
21.03166	Rem and Relay RCP Storm Drain, 66"	STORM DRAINAGE	LF
21.03172	Rem and Relay RCP Storm Drain, 72"	STORM DRAINAGE	LF
21.03215	Rem and Salv RCP Storm Drain, 15"	STORM DRAINAGE	LF
21.03218	Rem and Salv RCP Storm Drain, 18"	STORM DRAINAGE	LF
21.03221	Rem and Salv RCP Storm Drain, 21"	STORM DRAINAGE	LF
21.03224	Rem and Salv RCP Storm Drain, 24"	STORM DRAINAGE	LF
21.03230	Rem and Salv RCP Storm Drain, 30"	STORM DRAINAGE	LF
21.03236	Rem and Salv RCP Storm Drain, 36"	STORM DRAINAGE	LF
21.03242	Rem and Salv RCP Storm Drain, 42"	STORM DRAINAGE	LF
21.03248	Rem and Salv RCP Storm Drain, 48"	STORM DRAINAGE	LF
21.03254	Rem and Salv RCP Storm Drain, 54"	STORM DRAINAGE	LF
21.03260	Rem and Salv RCP Storm Drain, 60"	STORM DRAINAGE	LF
21.03266	Rem and Salv RCP Storm Drain, 66"	STORM DRAINAGE	LF
21.03272	Rem and Salv RCP Storm Drain, 72"	STORM DRAINAGE	LF
21.03315	RCP Storm Drain, Cl III, 15"	STORM DRAINAGE	LF
21.03318	RCP Storm Drain, Cl III, 18"	STORM DRAINAGE	LF
21.03321	RCP Storm Drain, Cl III, 21"	STORM DRAINAGE	LF
21.03324	RCP Storm Drain, Cl III, 24"	STORM DRAINAGE	LF
21.03330	RCP Storm Drain, Cl III, 30"	STORM DRAINAGE	LF
21.03336	RCP Storm Drain, Cl III, 36"	STORM DRAINAGE	LF
21.03342	RCP Storm Drain, Cl III, 42"	STORM DRAINAGE	LF
21.03348	RCP Storm Drain, Cl III, 48"	STORM DRAINAGE	LF
21.03354	RCP Storm Drain, Cl III, 54"	STORM DRAINAGE	LF
21.03360	RCP Storm Drain, Cl III, 60"	STORM DRAINAGE	LF
21.03372	RCP Storm Drain, Cl III, 72"	STORM DRAINAGE	LF
21.03415	RCP Storm Drain, Cl IV, 15"	STORM DRAINAGE	LF
21.03418	RCP Storm Drain, Cl IV, 18"	STORM DRAINAGE	LF
21.03421	RCP Storm Drain, Cl IV, 21"	STORM DRAINAGE	LF
21.03424	RCP Storm Drain, Cl IV, 24"	STORM DRAINAGE	LF
21.03430	RCP Storm Drain, Cl IV, 30"	STORM DRAINAGE	LF
21.03436	RCP Storm Drain, Cl IV, 36"	STORM DRAINAGE	LF
21.03442	RCP Storm Drain, Cl IV, 42"	STORM DRAINAGE	LF
21.03448	RCP Storm Drain, Cl IV, 48"	STORM DRAINAGE	LF
21.03454	RCP Storm Drain, Cl IV, 54"	STORM DRAINAGE	LF
21.03460	RCP Storm Drain, Cl IV, 60"	STORM DRAINAGE	LF
21.03472	RCP Storm Drain, Cl IV, 72"	STORM DRAINAGE	LF
21.03515	RCP Storm Drain, Cl V, 15"	STORM DRAINAGE	LF
21.03518	RCP Storm Drain, Cl V, 18"	STORM DRAINAGE	LF
21.03521	RCP Storm Drain, Cl V, 21"	STORM DRAINAGE	LF
21.03524	RCP Storm Drain, Cl V, 24"	STORM DRAINAGE	LF
21.03530	RCP Storm Drain, Cl V, 30"	STORM DRAINAGE	LF
21.03536	RCP Storm Drain, Cl V, 36"	STORM DRAINAGE	LF
21.03542	RCP Storm Drain, Cl V, 42"	STORM DRAINAGE	LF

Standard Item No.	Standard Item Description	Section	Unit
21.03548	RCP Storm Drain, CI V, 48"	STORM DRAINAGE	LF
21.03554	RCP Storm Drain, CI V, 54"	STORM DRAINAGE	LF
21.03560	RCP Storm Drain, CI V, 60"	STORM DRAINAGE	LF
21.03572	RCP Storm Drain, CI V, 72"	STORM DRAINAGE	LF
21.03614	Ellip RCP Storm Drain, 14" x 23"	STORM DRAINAGE	LF
21.03619	Ellip RCP Storm Drain, 19" x 30"	STORM DRAINAGE	LF
21.03624	Ellip RCP Storm Drain, 24" x 38"	STORM DRAINAGE	LF
21.03629	Ellip RCP Storm Drain, 29" x 45"	STORM DRAINAGE	LF
21.03634	Ellip RCP Storm Drain, 34" x 53"	STORM DRAINAGE	LF
21.03638	Ellip RCP Storm Drain, 38" x 60"	STORM DRAINAGE	LF
21.03643	Ellip RCP Storm Drain, 43" x 68"	STORM DRAINAGE	LF
21.03648	Ellip RCP Storm Drain, 48" x 76"	STORM DRAINAGE	LF
21.03653	Ellip RCP Storm Drain, 53" x 83"	STORM DRAINAGE	LF
21.03700	Precast RC Box Storm Drain	STORM DRAINAGE	LF
21.05001	Tap Ex Storm Drain MH & Replace	STORM DRAINAGE	EA
21.05002	Tap Ex Storm Drain Inlet & Replace	STORM DRAINAGE	EA
21.05003	Tap Ex RC Pipe	STORM DRAINAGE	EA
21.05004	Tap Ex RC Box	STORM DRAINAGE	EA
21.06001	Reinf Steel for Structures	STORM DRAINAGE	LBS
21.06002	Conc for Structures	STORM DRAINAGE	CY
21.07015	Storm Drain MH, 15" - 30"	STORM DRAINAGE	EA
21.07036	Storm Drain MH, to 36"	STORM DRAINAGE	EA
21.07042	Storm Drain MH, 42"	STORM DRAINAGE	EA
21.07048	Storm Drain MH, 42"-48"	STORM DRAINAGE	EA
21.07054	Storm Drain MH, 54"	STORM DRAINAGE	EA
21.07060	Storm Drain MH, 54"-60"	STORM DRAINAGE	EA
21.07066	Storm Drain MH, 66"	STORM DRAINAGE	EA
21.07072	Storm Drain MH, 66"-72"	STORM DRAINAGE	EA
21.07078	Storm Drain MH, 78"	STORM DRAINAGE	EA
21.08001	Storm Drain Inlet, 72"	STORM DRAINAGE	EA
21.08002	Canted Storm Drain Inlet, 72"	STORM DRAINAGE	EA
21.08003	Radius Storm Drain Inlet, 72"	STORM DRAINAGE	EA
21.08004	Storm Drain Inlet, Armored	STORM DRAINAGE	EA
21.08005	Canted Storm Drain Inlet, Armored	STORM DRAINAGE	EA
21.08006	Storm Drain Inlet Top Only, 72"	STORM DRAINAGE	EA
21.08007	Storm Drain Inlet Top Only, 72" Armored Face	STORM DRAINAGE	EA
21.08008	Reconstruct Inlet Throat	STORM DRAINAGE	EA
21.08009	Reconstruct Inlet Vault	STORM DRAINAGE	EA
21.08010	Grate Inlet, Ty "E"	STORM DRAINAGE	EA
21.08011	Grate Inlet, Ty "F-1"	STORM DRAINAGE	EA
21.08012	Grate Inlet, Ty "F-2"	STORM DRAINAGE	EA
21.08013	Grate Inlet, Ty "F-3"	STORM DRAINAGE	EA
21.08014	Grate Inlet, Ty "H"	STORM DRAINAGE	EA
21.09001	Convert Inlet to MH	STORM DRAINAGE	EA
21.10001	Channel Excavation	STORM DRAINAGE	CY
21.11002	RC Low Flow Liner, 2'	STORM DRAINAGE	LF

Standard Item No.	Standard Item Description	Section	Unit
21.11003	RC Low Flow Liner, 3'	STORM DRAINAGE	LF
21.11004	RC Low Flow Liner, 4'	STORM DRAINAGE	LF
21.11005	RC Low Flow Liner, 5'	STORM DRAINAGE	LF
21.11006	RC Low Flow Liner, 6'	STORM DRAINAGE	LF
21.11007	RC Low Flow Liner, 7'	STORM DRAINAGE	LF
21.11008	RC Low Flow Liner, 8'	STORM DRAINAGE	LF
21.11009	RC Low Flow Liner, 9'	STORM DRAINAGE	LF
21.11010	RC Low Flow Liner, 10'	STORM DRAINAGE	LF
21.12015	Rem RC FES, 15"	STORM DRAINAGE	EA
21.12018	Rem RC FES, 18"	STORM DRAINAGE	EA
21.12021	Rem RC FES, 21"	STORM DRAINAGE	EA
21.12024	Rem RC FES, 24"	STORM DRAINAGE	EA
21.12030	Rem RC FES, 30"	STORM DRAINAGE	EA
21.12036	Rem RC FES, 36"	STORM DRAINAGE	EA
21.12042	Rem RC FES, 42"	STORM DRAINAGE	EA
21.12048	Rem RC FES, 48"	STORM DRAINAGE	EA
21.12054	Rem RC FES, 54"	STORM DRAINAGE	EA
21.12060	Rem RC FES, 60"	STORM DRAINAGE	EA
21.12066	Rem RC FES, 66"	STORM DRAINAGE	EA
21.12072	Rem RC FES, 72"	STORM DRAINAGE	EA
21.12115	Rem & Reset RC FES, 15"	STORM DRAINAGE	EA
21.12118	Rem & Reset RC FES, 18"	STORM DRAINAGE	EA
21.12124	Rem & Reset RC FES, 24"	STORM DRAINAGE	EA
21.12130	Rem & Reset RC FES, 30"	STORM DRAINAGE	EA
21.12136	Rem & Reset RC FES, 36"	STORM DRAINAGE	EA
21.12142	Rem & Reset RC FES, 42"	STORM DRAINAGE	EA
21.12148	Rem & Reset RC FES, 48"	STORM DRAINAGE	EA
21.12154	Rem & Reset RC FES, 54"	STORM DRAINAGE	EA
21.12160	Rem & Reset RC FES, 60"	STORM DRAINAGE	EA
21.12166	Rem & Reset RC FES, 66"	STORM DRAINAGE	EA
21.12172	Rem & Reset RC FES, 72"	STORM DRAINAGE	EA
21.12215	RC FES, 15"	STORM DRAINAGE	EA
21.12218	RC FES, 18"	STORM DRAINAGE	EA
21.12224	RC FES, 24"	STORM DRAINAGE	EA
21.12230	RC FES, 30"	STORM DRAINAGE	EA
21.12236	RC FES, 36"	STORM DRAINAGE	EA
21.12242	RC FES, 42"	STORM DRAINAGE	EA
21.12248	RC FES, 48"	STORM DRAINAGE	EA
21.12254	RC FES, 54"	STORM DRAINAGE	EA
21.12260	RC FES, 60"	STORM DRAINAGE	EA
21.12272	RC FES, 72"	STORM DRAINAGE	EA
21.12315	RC FES, w/Grate, 15"	STORM DRAINAGE	EA
21.12318	RC FES, w/Grate, 18"	STORM DRAINAGE	EA
21.12324	RC FES, w/Grate, 24"	STORM DRAINAGE	EA
21.12330	RC FES, w/Grate, 30"	STORM DRAINAGE	EA
21.12336	RC FES, w/Grate, 36"	STORM DRAINAGE	EA

Standard Item No.	Standard Item Description	Section	Unit
21.12342	RC FES, w/Grate, 42"	STORM DRAINAGE	EA
21.12348	RC FES, w/Grate, 48"	STORM DRAINAGE	EA
21.12354	RC FES, w/Grate, 54"	STORM DRAINAGE	EA
21.12360	RC FES, w/Grate, 60"	STORM DRAINAGE	EA
21.12372	RC FES, w/Grate, 72"	STORM DRAINAGE	EA
21.13001	Rem Ex Manhole	STORM DRAINAGE	EA
21.13002	Rem Ex Inlet	STORM DRAINAGE	EA
21.13003	Rem Ex Junction Box	STORM DRAINAGE	EA
21.13004	Rem Ex Grate Inlet	STORM DRAINAGE	EA
21.13005	Rem Ex Hdwl	STORM DRAINAGE	EA
21.13006	Rem Ex Inlet Top Only	STORM DRAINAGE	EA
21.14001	Rip-Rap, Typ A	STORM DRAINAGE	TON
21.14002	Rip-Rap, Typ A w/Filter Fabric	STORM DRAINAGE	TON
21.14003	Rip-Rap, Typ B	STORM DRAINAGE	TON
21.14004	Rip-Rap, Typ B w/Fabric Filter	STORM DRAINAGE	TON
21.14005	Rip-Rap, Typ C	STORM DRAINAGE	TON
21.14006	Rip-Rap, Typ C w/Fabric Filter	STORM DRAINAGE	TON
21.15001	Wire Gabion	STORM DRAINAGE	EA
21.15002	Wire Gabion PVC Coated	STORM DRAINAGE	EA
21.16001	Geotextile Filter Fabric	STORM DRAINAGE	SY
21.17001	Tied Concrete Block Mat	STORM DRAINAGE	SY
22.03001	Tap Ex MH and Replace Invert	WASTEWATER	EA
22.03002	Convert Ex MH to Drop MH	WASTEWATER	EA
22.03101	Rem Ex Sanitary Sewer MH	WASTEWATER	EA
22.03102	Fill and Abandon Ex MH	WASTEWATER	EA
22.04001	Abandonment of Sanitary Sewer Main	WASTEWATER	EA
22.05000	Sanitary Sewer Pipe (C900 PVC), 8"	WASTEWATER	LF
22.05008	Sanitary Sewer Pipe, 8"	WASTEWATER	LF
22.05010	Sanitary Sewer Pipe, 10"	WASTEWATER	LF
22.05012	Sanitary Sewer Pipe, 12"	WASTEWATER	LF
22.05015	Sanitary Sewer Pipe, 15"	WASTEWATER	LF
22.05018	Sanitary Sewer Pipe, 18"	WASTEWATER	LF
22.05021	Sanitary Sewer Pipe, 21"	WASTEWATER	LF
22.05024	Sanitary Sewer Pipe, 24"	WASTEWATER	LF
22.05027	Sanitary Sewer Pipe, 27"	WASTEWATER	LF
22.05048	Sanitary Sewer Pipe, 48"	WASTEWATER	LF
22.05208	Sanitary Sewer Plug, 8"	WASTEWATER	EA
22.05210	Sanitary Sewer Plug, 10"	WASTEWATER	EA
22.07001	Std MH, Ty "G"	WASTEWATER	EA
22.07002	Std MH, Ty "P"	WASTEWATER	EA
22.07003	Std MH, Ty "S"	WASTEWATER	EA
22.07101	Std MH, Ty "G" VF	WASTEWATER	VF
22.07102	Std MH, Ty "P" VF	WASTEWATER	VF
22.07103	Std MH, Ty "S" VF	WASTEWATER	VF
22.07201	Std Drop MH, Ty "H"	WASTEWATER	EA
22.07202	Std Drop MH, Ty "Q"	WASTEWATER	EA

Standard Item No.	Standard Item Description	Section	Unit
22.07203	Std Drop MH, Ty "R"	WASTEWATER	EA
22.07301	Std Drop MH, Ty "H" VF	WASTEWATER	VF
22.07302	Std Drop MH, Ty "Q" VF	WASTEWATER	VF
22.07303	Std Drop MH, Ty "R" VF	WASTEWATER	VF
22.08084	Wye, 8" X 4"	WASTEWATER	EA
22.08086	Wye, 8" x 6"	WASTEWATER	EA
22.08104	Wye, 10" x 4"	WASTEWATER	EA
22.08106	Wye, 10" x 6"	WASTEWATER	EA
22.08201	Construct Sanitary Sewer Service	WASTEWATER	EA
22.08202	Reconstruct Sanitary Sewer Service	WASTEWATER	EA
22.08304	Pipe Sewer Service, 4"	WASTEWATER	LF
22.08306	Pipe Sewer Service, 6"	WASTEWATER	LF
22.08308	Pipe Sewer Service, 8"	WASTEWATER	LF
22.08400	Boring for Sewer Service Pipe	WASTEWATER	LF
23.04004	Rem 4" Water Main	WATER	LF
23.04006	Rem 6" Water Main	WATER	LF
23.04008	Rem 8" Water Main	WATER	LF
23.04010	Rem 10" Water Main	WATER	LF
23.04012	Rem 12" Water Main	WATER	LF
23.04016	Rem 16" Water Main	WATER	LF
23.04020	Rem 20" Water Main	WATER	LF
23.04024	Rem 24" Water Main	WATER	LF
23.04030	Rem 30" Water Main	WATER	LF
23.04036	Rem 36" Water Main	WATER	LF
23.04101	Rem & Salvage Hydrant	WATER	EA
23.04102	Rem & Salvage Plug	WATER	EA
23.04103	Rem & Salvage Anchoring Coupling	WATER	EA
23.04104	Rem & Salvage Anchoring Pipe	WATER	EA
23.04105	Rem & Salvage Gate Valve and Box	WATER	EA
23.04106	Rem & Salvage Reducer	WATER	EA
23.04107	Rem & Salvage Bend	WATER	EA
23.04108	Rem & Salvage Cross	WATER	EA
23.04109	Rem & Salvage Tee	WATER	EA
23.04111	Rem & Reset Hydrant	WATER	EA
23.04112	Rem & Reset Plug	WATER	EA
23.04113	Rem & Reset Anchoring Coupling	WATER	EA
23.04114	Rem & Reset Anchoring Pipe	WATER	EA
23.04115	Rem & Reset Gate Valve and Box	WATER	EA
23.04116	Rem & Reset Reducer	WATER	EA
23.04117	Rem & Reset Bend	WATER	EA
23.04118	Rem & Reset Cross	WATER	EA
23.04119	Rem & Reset Tee	WATER	EA
23.04121	Rem Hydrant	WATER	EA
23.04122	Rem Plug	WATER	EA
23.04123	Rem Anchoring Coupling	WATER	EA
23.04124	Rem Anchoring Pipe	WATER	EA

Standard Item No.	Standard Item Description	Section	Unit
23.04125	Rem Gate Valve and Box	WATER	EA
23.04126	Rem Reducer	WATER	EA
23.04127	Rem Bend	WATER	EA
23.04128	Rem Cross	WATER	EA
23.04129	Rem Tee	WATER	EA
23.07004	Water Main, 4"	WATER	LF
23.07006	Water Main, 6"	WATER	LF
23.07008	Water Main, 8"	WATER	LF
23.07012	Water Main, 12"	WATER	LF
23.07016	Water Main, 16"	WATER	LF
23.07024	Water Main, 24"	WATER	LF
23.07030	Water Main, 30"	WATER	LF
23.07070	Anchoring Elbow, MJ, 6"	WATER	EA
23.07071	Anchoring Coupling, MJ (L=12"), 6"	WATER	EA
23.07072	Anchoring Coupling, MJ (L=18"), 6"	WATER	EA
23.07073	Anchoring Coupling, MJ (L=24"), 6"	WATER	EA
23.07074	Anchoring Coupling, MJ (L=36"), 6"	WATER	EA
23.07075	Anchoring Coupling, MJ (L=13"), 8"	WATER	EA
23.07080	Reducer, MJ, 6" X 4"	WATER	EA
23.07081	Reducer, MJ, 8" X 6"	WATER	EA
23.07082	Reducer, MJ, 12" X 6"	WATER	EA
23.07083	Reducer, MJ, 12" x 8"	WATER	EA
23.07084	Reducer, MJ, 16" X 6"	WATER	EA
23.07085	Reducer, MJ, 16" x 8"	WATER	EA
23.07086	Reducer, MJ, 16" X 12"	WATER	EA
23.07087	Reducer, MJ, 24" X 12"	WATER	EA
23.07088	Reducer, MJ, 24" X 16"	WATER	EA
23.07089	Reducer, MJ, 30" X 12"	WATER	EA
23.07090	Reducer, MJ, 30" X 16"	WATER	EA
23.07091	Reducer, MJ, 30" X 24"	WATER	EA
23.07100	Deg Bend, MJ, 4" x 90	WATER	EA
23.07101	Deg Bend, MJ, 6" X 90	WATER	EA
23.07102	Deg Bend, MJ, 8" x 90	WATER	EA
23.07103	Deg Bend, MJ, 12" X 90	WATER	EA
23.07104	Deg Bend, MJ, 16" X 90	WATER	EA
23.07105	Deg Bend, MJ, 24" X 90	WATER	EA
23.07106	Deg Bend, MJ, 30" X 90	WATER	EA
23.07110	Deg Bend, MJ, 6" X 45	WATER	EA
23.07111	Deg Bend, MJ, 8" X 45	WATER	EA
23.07112	Deg Bend, MJ, 12" X 45	WATER	EA
23.07113	Deg Bend, MJ, 16" X 45	WATER	EA
23.07114	Deg Bend, MJ, 24" X 45	WATER	EA
23.07115	Deg Bend, MJ, 30" X 45	WATER	EA
23.07121	Deg Bend, MJ, 6" X 22.5	WATER	EA
23.07122	Deg Bend, MJ, 8" X 22.5	WATER	EA
23.07123	Deg Bend, MJ, 12" X 22.5	WATER	EA

Standard Item No.	Standard Item Description	Section	Unit
23.07124	Deg Bend, MJ, 16" X 22.5	WATER	EA
23.07125	Deg Bend, MJ, 24" X 22.5	WATER	EA
23.07126	Deg Bend, MJ, 30" X 22.5	WATER	EA
23.07131	Deg Bend, MJ, 6" X 11.25	WATER	EA
23.07132	Deg Bend, MJ, 8" X 11.25	WATER	EA
23.07133	Deg Bend, MJ, 12" X 11.25	WATER	EA
23.07134	Deg Bend, MJ, 16" X 11.25	WATER	EA
23.07135	Deg Bend, MJ, 24" X 11.25	WATER	EA
23.07136	Deg Bend, MJ, 30" X 11.25	WATER	EA
23.07200	Cross, MJ, 8" x 6"	WATER	EA
23.07201	Cross, MJ, 6" X 6"	WATER	EA
23.07202	Cross, MJ, 8" x 8"	WATER	EA
23.07203	Cross, MJ, 12" X 6"	WATER	EA
23.07204	Cross, MJ, 12" X 12"	WATER	EA
23.07205	Cross, MJ, 16" X 6"	WATER	EA
23.07206	Cross, MJ, 16" X 12"	WATER	EA
23.07207	Cross, MJ, 16" X 16"	WATER	EA
23.07208	Cross, MJ, 24" X 6"	WATER	EA
23.07209	Cross, MJ, 24" x 8"	WATER	EA
23.07210	Cross, MJ, 24" X 12"	WATER	EA
23.07211	Cross, MJ, 24" X 16"	WATER	EA
23.07212	Cross, MJ, 24" X 24"	WATER	EA
23.07213	Cross, MJ, 30" X 6"	WATER	EA
23.07214	Cross, MJ, 30" X 12"	WATER	EA
23.07215	Cross, MJ, 30" X 16"	WATER	EA
23.07216	Cross, MJ, 30" X 24"	WATER	EA
23.07217	Cross, MJ, 30" X 30"	WATER	EA
23.07218	Cross, MJ, 12" X 8"	WATER	EA
23.07300	Tee, MJ, 6" X 4"	WATER	EA
23.07301	Tee, MJ, 6" X 6"	WATER	EA
23.07302	Tee, MJ, 8" X 6"	WATER	EA
23.07303	Tee, MJ, 8" X 8"	WATER	EA
23.07304	Tee, MJ, 12" X 6"	WATER	EA
23.07305	Tee, MJ, 12" x 8"	WATER	EA
23.07306	Tee, MJ, 12" X 12"	WATER	EA
23.07307	Tee, MJ, 16" X 6"	WATER	EA
23.07308	Tee, MJ, 16" X 8"	WATER	EA
23.07309	Tee, MJ, 16" X 12"	WATER	EA
23.07310	Tee, MJ, 16" X 16"	WATER	EA
23.07311	Tee, MJ, 24" X 6"	WATER	EA
23.07312	Tee, MJ, 24" X 8"	WATER	EA
23.07313	Tee, MJ, 24" X 12"	WATER	EA
23.07314	Tee, MJ, 24" X 16"	WATER	EA
23.07315	Tee, MJ, 24" X 24"	WATER	EA
23.07316	Tee, MJ, 30" X 6"	WATER	EA
23.07317	Tee, MJ, 30" X 8"	WATER	EA

Standard Item No.	Standard Item Description	Section	Unit
23.07318	Tee, MJ, 30" X 12"	WATER	EA
23.07319	Tee, MJ, 30" X 16"	WATER	EA
23.07320	Tee, MJ, 30" X 24"	WATER	EA
23.07321	Tee, MJ, 30" X 30"	WATER	EA
23.07350	Swivel Tee, MJ, 6" X 6"	WATER	EA
23.07351	Swivel Tee, MJ, 8" X 6"	WATER	EA
23.07352	Swivel Tee, MJ, 12" X 6"	WATER	EA
23.07353	Swivel Tee, MJ, 16" X 6"	WATER	EA
23.07354	Swivel Tee, MJ, 24" X 6"	WATER	EA
23.07355	Swivel Tee, MJ, 30" X 6"	WATER	EA
23.07400	Offset, 12" Drop, MJ, 6"	WATER	EA
23.07401	Offset, 18" Drop, MJ, 6"	WATER	EA
23.07402	Offset, 24" Drop, MJ, 6"	WATER	EA
23.07403	Offset, 12" Drop, MJ, 8"	WATER	EA
23.07404	Offset, 18" Drop, MJ, 8"	WATER	EA
23.07405	Offset, 24" Drop, MJ, 8"	WATER	EA
23.07406	Offset, 12" Drop, MJ, 12"	WATER	EA
23.07407	Offset, 18" Drop, MJ, 12"	WATER	EA
23.07408	Offset, 12" Drop, MJ, 16"	WATER	EA
23.07409	Offset, 18" Drop, MJ, 16"	WATER	EA
23.07506	Solid Sleeve, MJ (L=12"), 6"	WATER	EA
23.07507	Solid Sleeve, MJ (L=18"), 6"	WATER	EA
23.07508	Solid Sleeve, MJ (L=12"), 8"	WATER	EA
23.07509	Solid Sleeve, MJ (L=18"), 8"	WATER	EA
23.07512	Solid Sleeve, MJ (L=12"), 12"	WATER	EA
23.07516	Solid Sleeve, MJ (L=15"), 16"	WATER	EA
23.07524	Solid Sleeve, MJ (L=15"), 24"	WATER	EA
23.07530	Solid Sleeve, MJ (L=15"), 30"	WATER	EA
23.07604	Dual Purpose Sleeve, MJ (L=12"), 4"	WATER	EA
23.07606	Dual Purpose Sleeve, MJ (L=12"), 6"	WATER	EA
23.07608	Dual Purpose Sleeve, MJ (L=12"), 8"	WATER	EA
23.07612	Dual Purpose Sleeve, MJ (L=12"), 12"	WATER	EA
23.07616	Dual Purpose Sleeve, MJ (L=15"), 16"	WATER	EA
23.07704	Plug, MJ, 4"	WATER	EA
23.07706	Plug, MJ, 6"	WATER	EA
23.07708	Plug, MJ, 8"	WATER	EA
23.07712	Plug, MJ, 12"	WATER	EA
23.07716	Plug, MJ, 16"	WATER	EA
23.07724	Plug, MJ, 24"	WATER	EA
23.07730	Plug, MJ, 30"	WATER	EA
23.07804	Retainer Glands, MJ, 4"	WATER	EA
23.07806	Retainer Glands, MJ, 6"	WATER	EA
23.07808	Retainer Glands, MJ, 8"	WATER	EA
23.07812	Retainer Glands, MJ, 12"	WATER	EA
23.07816	Retainer Glands, MJ, 16"	WATER	EA
23.07824	Retainer Glands, MJ, 24"	WATER	EA

Standard Item No.	Standard Item Description	Section	Unit
23.07830	Retainer Glands, MJ, 30"	WATER	EA
23.07904	Restraint Adaptor, MJ, 4"	WATER	EA
23.07906	Restraint Adaptor, MJ, 6"	WATER	EA
23.07908	Restraint Adaptor, MJ, 8"	WATER	EA
23.07912	Restraint Adaptor, MJ, 12"	WATER	EA
23.08006	Gate Valve, MJ, 6"	WATER	EA
23.08008	Gate Valve, MJ, 8"	WATER	EA
23.08012	Gate Valve, MJ, 12"	WATER	EA
23.08112	Butterfly Valve, MJ, 12"	WATER	EA
23.08116	Butterfly Valve, MJ, 16"	WATER	EA
23.08124	Butterfly Valve, MJ, 24"	WATER	EA
23.08130	Butterfly Valve, MJ, 30"	WATER	EA
23.08201	Tapping Sleeve & Valve, MJ, 4" x 4"	WATER	EA
23.08202	Tapping Sleeve & Valve, MJ, 6" x 4"	WATER	EA
23.08203	Tapping Sleeve & Valve, MJ, 6" x 6"	WATER	EA
23.08204	Tapping Sleeve & Valve, MJ, 8" x 4"	WATER	EA
23.08205	Tapping Sleeve & Valve, MJ, 8" x 6"	WATER	EA
23.08206	Tapping Sleeve & Valve, MJ, 8" x 8"	WATER	EA
23.08208	Tapping Sleeve & Valve, MJ, 12" x 4"	WATER	EA
23.08209	Tapping Sleeve & Valve, MJ, 12" x 6"	WATER	EA
23.08210	Tapping Sleeve & Valve, MJ, 12" x 8"	WATER	EA
23.08211	Tapping Sleeve & Valve, MJ, 12" x 12"	WATER	EA
23.08212	Tapping Sleeve & Valve, MJ, 16" x 4"	WATER	EA
23.08213	Tapping Sleeve & Valve, MJ, 16" x 6"	WATER	EA
23.08214	Tapping Sleeve & Valve, MJ, 16" x 8"	WATER	EA
23.08215	Tapping Sleeve & Valve, MJ, 16" x 12"	WATER	EA
23.08216	Tapping Sleeve & Valve, MJ, 16" x 16"	WATER	EA
23.08217	Tapping Sleeve & Valve, MJ, 20" x 4"	WATER	EA
23.08218	Tapping Sleeve & Valve, MJ, 20" x 6"	WATER	EA
23.08219	Tapping Sleeve & Valve, MJ, 20" x 8"	WATER	EA
23.08220	Tapping Sleeve & Valve, MJ, 20" x 12"	WATER	EA
23.08221	Tapping Sleeve & Valve, MJ, 20" x 16"	WATER	EA
23.08222	Tapping Sleeve & Valve, MJ, 24" x 4"	WATER	EA
23.08223	Tapping Sleeve & Valve, MJ, 24" x 6"	WATER	EA
23.08224	Tapping Sleeve & Valve, MJ, 24" x 8"	WATER	EA
23.08225	Tapping Sleeve & Valve, MJ, 24" x 12"	WATER	EA
23.08226	Tapping Sleeve & Valve, MJ, 24" x 16"	WATER	EA
23.08355	Hydrant, L=5.5'	WATER	EA
23.08365	Hydrant, L=6.5'	WATER	EA
23.08400	Hydrant Extension	WATER	EA
23.09000	Bentomat Geosynthetic Clay Lining	WATER	SF
23.10001	Temporary Hydrant and Blow-off	WATER	EA
23.11075	Copper Water Service Pipe, 0.75"	WATER	LF
23.11100	Copper Water Service Pipe, 1"	WATER	LF
23.11125	Copper Water Service Pipe, 1.25"	WATER	LF
23.11150	Copper Water Service Pipe, 1.5"	WATER	LF

Standard Item No.	Standard Item Description	Section	Unit
23.11200	Copper Water Service Pipe, 2"	WATER	LF
23.11475	Boring For 0.75" Water Service Pipe	WATER	LF
23.11500	Boring For 1" Water Service Pipe	WATER	LF
23.11525	Boring For 1.25" Water Service Pipe	WATER	LF
23.11550	Boring For 1.5" Water Service Pipe	WATER	LF
23.11600	Boring For 2" Water Service Pipe	WATER	LF
23.11700	Loop Water Service	WATER	EA
23.11900	Construct Water Service	WATER	EA
23.11901	Reconstruct Water Service	WATER	EA
23.12001	Abandonment of Water Main	WATER	LS
23.20000	Corrosion Control System	WATER	LS
24.01000	Rem Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01001	Rem Pedestrian Signal	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01010	Rem Mast Arm Pole	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01011	Rem Span Wire Pole	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01012	Rem Street Light Pole	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01013	Rem Pedestal Pole	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01014	Rem Cabinet	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01015	Rem Down Guy	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01016	Rem Riser	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01022	Rem Pull Box	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01023	Rem Concrete Pull Box	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01030	Rem Cable	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.01040	Rem Overhead Cable	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.01050	Rem Head On Mast Arm	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01051	Rem Head On Shaft	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01052	Rem Pedestrian Push Button	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01053	Rem Luminaire	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01054	Rem Detector Camera	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01055	Rem Metro Street Name Sign	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01100	Rel Mast Arm Pole	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01102	Rel Street Light Pole	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01110	Rel Cable	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.01121	Rel Metro Street Name Sign	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01122	Rel LED Sign	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01200	Adj Head On Mast Arm	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.01201	Adj Head On Shaft	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.02000	Inst and Rem Temp Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.02001	Inst and Rem Temp Head	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.03115	Conduit, 1 1/2", Bored	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03120	Conduit, 2", Bored	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03130	Conduit, 3", Bored	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03140	Conduit, 4", Bored	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03161	Conduit, Main Line Group Bored	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03205	Conduit, 1/2", Trenched	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03215	Conduit, 1 1/2", Trenched	TRAFFIC SIGNAL, ITS & LIGHTING	LF

Standard Item No.	Standard Item Description	Section	Unit
24.03220	Conduit, 2", Trenched	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03230	Conduit, 3", Trenched	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03240	Conduit, 4", Trenched	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.03261	Conduit, Main Line Group Trenched	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.05006	Pull Box, T6	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.05009	Pull Box, T9	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.05027	Pull Box, TR27	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.05048	Pull Box, T48	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.06015	Riser, 1 1/2"	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.06020	Riser, 2"	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.06040	Riser, 4"	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.07001	Electrical Meter Pedestal	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08300	Inst Mast Arm	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08301	Rotate Mast Arm	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08430	Pole, Street Light, SL-A-C-30-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08435	Pole, Street Light, SL-A-C-35-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08440	Pole, Street Light, SL-A-C-40-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08445	Pole, Street Light, SL-A-C-45-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08450	Pole, Street Light, SL-A-C-50-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08530	Pole, Street Light, SL-A-PI-30-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08535	Pole, Street Light, SL-A-PI-35-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08540	Pole, Street Light, SL-A-PI-40-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08545	Pole, Street Light, SL-A-PI-45-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08550	Pole, Street Light, SL-A-PI-50-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08630	Pole, Street Light, SCSL-A-C-30-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08635	Pole, Street Light, SCSL-A-C-35-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08640	Pole, Street Light, SCSL-A-C-40-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08645	Pole, Street Light, SCSL-A-C-45-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08650	Pole, Street Light, SCSL-A-C-50-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08700	Pole, Inst Pedestal, PPB	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08701	Pole, Inst Pedestal, 1	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08703	Pole, Inst Pedestal, 3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08800	Pole, Inst Concrete, Direct Buried	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08930	Pole, Street Light, SL-EM-30-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08935	Pole, Street Light, SL-EM-35-6-3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08940	Pole, Street Light, SL-EM-40-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08945	Pole, Street Light, SL-EM-45-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.08950	Pole, Street Light, SL-EM-50-12T-5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.09000	Ground Rod	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.10016	Detector, Loop, Sawed Under Overlay	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.10017	Detector, Loop, Preformed Under Street	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.10020	Detector, Inst Non-Intrusive	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.10200	Detector, Inst Pedestrian Push Button	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.10300	Detector, Inst Camera	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.10301	Detector, Inst Emergency	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.11007	Cabinet, Inst ITS, Pole Mount	TRAFFIC SIGNAL, ITS & LIGHTING	EA

Standard Item No.	Standard Item Description	Section	Unit
24.11008	Cabinet, Inst ITS, Pad Mount	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.11009	Cabinet, Inst Signal, Pad Mount	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.11010	Cabinet, Base	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.12000	Cable, Inst	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.12003	Cable, 3/C Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12005	Cable, 5/C Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12007	Cable, 7/C Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12012	Cable, 12/C Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12016	Cable, 16/C Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12020	Cable, 20/C Traffic Signal	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12101	Cable, Lead-In	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12103	Cable, Emergency Detector	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12104	Cable, Ethernet Communications	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12184	Cable, RRFB	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12802	Cable, No 2	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12804	Cable, No 4	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12806	Cable, No 6	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12808	Cable, No 8	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12902	Cable, No 2 DB	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12904	Cable, No 4 DB	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12906	Cable, No 6 DB	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12908	Cable, No 8 DB	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.12910	Cable, No 10 DB	TRAFFIC SIGNAL, ITS & LIGHTING	LF
24.13013	Head, Inst Pedestrian Signal	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13063	Sign, Inst Overhead	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13074	Inst Speed Indicator on Shaft	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13075	Rectangular Rapid Flashing Beacon, Inst	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13076	Advanced Flasher On Mast Arm, Inst	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13077	Advanced Flasher On Shaft, Inst	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13103	Head, Inst Traffic Signal, 3 Section	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13104	Head, Inst Traffic Signal, 4 Section	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.13105	Head, Inst Traffic Signal, 5 Section	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14261	Luminaire, 26' Grey LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14262	Luminaire, 26' Black LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14331	Luminaire, 33' Grey LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14332	Luminaire, 33' Black LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14381	Luminaire, 38' Grey LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14382	Luminaire, 38' Black LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14521	Luminaire, 52' Grey LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14522	Luminaire, 52' Black LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14801	Luminaire, 80' Grey LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14802	Luminaire, 80' Black LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14921	Luminaire, 92' Grey LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14922	Luminaire, 92' Black LED-PC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.14991	Luminaire, Downtown Grey LED-SC	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.16001	Camera, Inst Traffic Monitoring	TRAFFIC SIGNAL, ITS & LIGHTING	EA

Standard Item No.	Standard Item Description	Section	Unit
24.17001	Radio Antenna, Inst	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.18355	Wood Pole, 35/5	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.18402	Wood Pole, 40/2	TRAFFIC SIGNAL, ITS & LIGHTING	EA
24.18403	Wood Pole, 40/3	TRAFFIC SIGNAL, ITS & LIGHTING	EA
26.02001	Fiber Marker	COMMUNICATIONS	EA
26.04001	Ground Bar	COMMUNICATIONS	EA
26.05110	Cable, Fiber Locate	COMMUNICATIONS	LF
26.05812	Cable, Fiber Optic 12 Strand, Single Mode	COMMUNICATIONS	LF
26.05824	Cable, Fiber Optic 24 Strand, Single Mode	COMMUNICATIONS	LF
26.05848	Cable, Fiber Optic 48 Strand, Single Mode	COMMUNICATIONS	LF
26.05896	Cable, Fiber Optic 96 Strand, Single Mode	COMMUNICATIONS	LF
26.06102	Fiber SC Connector	COMMUNICATIONS	EA
26.06103	Fiber SC Panel Pigtail	COMMUNICATIONS	EA
26.06105	Fiber Optic Cable Fusion Splice	COMMUNICATIONS	EA
26.06112	Fiber SC Connector, Inst	COMMUNICATIONS	EA
26.06113	Fiber SC Panel Pigtail, Inst	COMMUNICATIONS	EA
26.06201	Fiber Optic Cable Splice Enclosure, Small	COMMUNICATIONS	EA
26.06202	Fiber Optic Cable Splice Enclosure, Large	COMMUNICATIONS	EA
26.06211	Fiber Optic Cable Splice Enclosure, Small, Inst	COMMUNICATIONS	EA
26.06212	Fiber Optic Cable Splice Enclosure, Large, Inst	COMMUNICATIONS	EA
26.06300	Fiber Distribution Wall Mount Enclosure	COMMUNICATIONS	EA
26.06301	Fiber Distribution Rack Mount Enclosure	COMMUNICATIONS	EA
26.06302	Factory Terminated Patch Panel w/Pigtail, 4-Step	COMMUNICATIONS	EA
26.06303	Factory Terminated Patch Panel w/Pigtail, 6-Step	COMMUNICATIONS	EA
26.06310	Fiber Distribution Wall Mount Enclosure, Inst	COMMUNICATIONS	EA
26.06311	Fiber Distribution Rack Mount Enclosure, Inst	COMMUNICATIONS	EA
26.06312	Factory Terminated Patch Panel w/Pigtail, 4-Step, Inst	COMMUNICATIONS	EA
26.06313	Factory Terminated Patch Panel w/Pigtail, 6-Step, Inst	COMMUNICATIONS	EA
26.06422	Junction Box, 2' x 2'	COMMUNICATIONS	EA
26.06533	3", 3 Cell Fabric Innerduct	COMMUNICATIONS	LF
26.07001	ITS Field Switch, Inst	COMMUNICATIONS	EA
30.07001	Seeding, Ty "A"	SEEDING & SODDING	AC
30.07002	Seeding, Ty "B"	SEEDING & SODDING	AC
30.07003	Seeding, Ty "C"	SEEDING & SODDING	AC
30.07004	Seeding, Ty "D"	SEEDING & SODDING	AC
30.07005	Seeding, Ty "E"	SEEDING & SODDING	AC
30.07006	Seeding, Ty "F"	SEEDING & SODDING	AC
30.07007	Seeding, Ty "G"	SEEDING & SODDING	AC
30.07008	Seeding, Ty "H"	SEEDING & SODDING	AC
30.07009	Seeding, Ty "I"	SEEDING & SODDING	AC
30.07010	Seeding, Ty "J"	SEEDING & SODDING	AC
30.08001	Sodding	SEEDING & SODDING	SF
30.09001	Plugging	SEEDING & SODDING	SF
31.03001	Select Topsoil	LANDSCAPE	CY
32.01001	SWPPP Updating	EROSION & SEDIMENT CTRL	EA
32.02001	Synthetic Fabric Silt Fence Inst	EROSION & SEDIMENT CTRL	LF

Standard Item No.	Standard Item Description	Section	Unit
32.02002	Synthetic Fabric Silt Fence Maint	EROSION & SEDIMENT CTRL	LF
32.02003	Synthetic Fabric Silt Fence Rem	EROSION & SEDIMENT CTRL	LF
32.03001	Construction Entrance Surfacing	EROSION & SEDIMENT CTRL	TON
32.04001	Curb Inlet Protection Inst	EROSION & SEDIMENT CTRL	EA
32.04002	Curb Inlet Protection Maint	EROSION & SEDIMENT CTRL	EA
32.04003	Curb Inlet Protection Rem	EROSION & SEDIMENT CTRL	EA
32.05001	ECB, Type I	EROSION & SEDIMENT CTRL	SY
32.05002	ECB, Type II	EROSION & SEDIMENT CTRL	SY
32.05101	BD ECB, Type I	EROSION & SEDIMENT CTRL	SY
32.05102	BD ECB, Type II	EROSION & SEDIMENT CTRL	SY
32.06001	TRM, Type I	EROSION & SEDIMENT CTRL	SY
32.06002	TRM, Type II	EROSION & SEDIMENT CTRL	SY
32.07001	Triangular Sediment Barrier Inst	EROSION & SEDIMENT CTRL	LF
32.07002	Triangular Sediment Barrier Maint	EROSION & SEDIMENT CTRL	LF
32.07003	Triangular Sediment Barrier Rem	EROSION & SEDIMENT CTRL	LF
32.07004	Permeable A-Shaped Sediment Barrier Inst	EROSION & SEDIMENT CTRL	LF
32.07005	Permeable A-Shaped Sediment Barrier Maint	EROSION & SEDIMENT CTRL	LF
32.07006	Permeable A-Shaped Sediment Barrier Rem	EROSION & SEDIMENT CTRL	LF
32.07007	Temporary Earth/Soil Berm Inst	EROSION & SEDIMENT CTRL	LF
32.07008	Temporary Earth/Soil Berm Maint	EROSION & SEDIMENT CTRL	LF
32.07009	Temporary Earth/Soil Berm Rem	EROSION & SEDIMENT CTRL	LF
32.07010	Earth-Slash Mulch Check Inst	EROSION & SEDIMENT CTRL	LF
32.07011	Earth-Slash Mulch Check Maint	EROSION & SEDIMENT CTRL	LF
32.07012	Earth-Slash Mulch Check Rem	EROSION & SEDIMENT CTRL	LF
32.08001	Rock Ditch Check Inst	EROSION & SEDIMENT CTRL	LF
32.08002	Rock Ditch Check Maint	EROSION & SEDIMENT CTRL	LF
32.08003	Rock Ditch Check Rem	EROSION & SEDIMENT CTRL	LF
32.09001	Compost Filter Sock Inst	EROSION & SEDIMENT CTRL	LF
32.09002	Compost Filter Sock Maint	EROSION & SEDIMENT CTRL	LF
32.09003	Compost Filter Sock Rem	EROSION & SEDIMENT CTRL	LF
32.10001	Biodegradable Log Ditch Check Inst	EROSION & SEDIMENT CTRL	LF
32.10002	Biodegradable Log Ditch Check Maint	EROSION & SEDIMENT CTRL	LF
32.10003	Biodegradable Log Ditch Check Rem	EROSION & SEDIMENT CTRL	LF
32.12001	Coir Fiber Log	EROSION & SEDIMENT CTRL	LF
32.12002	Coir Fiber Log Maint	EROSION & SEDIMENT CTRL	LF
32.13001	SWPPP Sign Inst	EROSION & SEDIMENT CTRL	LF
32.13002	SWPPP Sign Maint	EROSION & SEDIMENT CTRL	LF
32.13003	SWPPP Sign Rem	EROSION & SEDIMENT CTRL	LF
50.00001	Misc EA	MISC	EA
50.00005	Misc LF	MISC	LF
50.00010	Misc CY	MISC	CY
50.00015	Misc LS	MISC	LS
50.00020	Misc AC	MISC	AC
50.00025	Misc LBS	MISC	LBS
50.00030	Misc VF	MISC	VF
50.00035	Misc TON	MISC	TON

Standard Item No.	Standard Item Description	Section	Unit
50.00040	Misc SY	MISC	SY
50.00045	Misc SF	MISC	SF
50.00050	Misc HRS	MISC	HRS
50.00055	Misc CFT	MISC	CFT
50.00060	Misc CDAY	MISC	CDAY
50.00065	Misc GAL	MISC	GAL
50.00070	Misc BALE	MISC	BALE