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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
ACI	-	American Concrete Institute
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
EEO	-	Equal Employment Opportunity
FHWA	-	Federal Highway Administration
IMSA	-	International Municipal Signal Association
IPCEA	-	Insulated Power Cable Engineers Association
LES	-	Lincoln Electric System
LSP	-	Lincoln Standard Plan
MUTCD	-	Manual Uniform Traffic Control Devices
NDOR	-	Nebraska Department of Roads
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electrical Safety Code
OSHA	-	Occupational Safety and Health Administration
SSP	-	State Standard Plan
UL	-	Underwriters Laboratories
USASI	-	USA Standards Institute

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. **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.

4. **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.

5. **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.

6. **Calendar Days**. Every day shown on the calendar. (Saturdays, Sundays and Holidays included).

7. **Change Order** shall mean a written instrument the Contract Administrator 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.

8. **City.** The City of Lincoln, Nebraska, and shall include the City's authorized representative.

9. **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.

10. **Claim** shall include a demand or assertion by the City or 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.

11. **Consultant** shall mean the designated architect or engineer the City employed, or design professional contracted to provide design and other professional services related to the project.

12. **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.

13. **Contract Administrator.** The Contract Administrator shall be the person designated by the Department Director responsible for the Project.

14. **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.

15. **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.

16. **Contract Completion Date.** The calendar date stipulated in the contract by which the proposed work shall be complete.

17. **County.** Lancaster County, Nebraska.

18. **Easement.** A right to use or control property for a designated purpose.

19. **Engineer.** The City Engineer or his/her designee.

20. **Equipment.** All machinery, tools, supplies necessary for maintenance, and apparatus necessary for the construction of the Work.

21. **Extra Work.** An item of work not originally a part of the contract, but necessary for completion and/or execution of the contract.

22. **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.

23. **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.

24. **Laboratory.** The City of Lincoln's Testing Laboratory or any other laboratory as may be designated by the Contract Administrator for the purpose of testing materials and/or work performed.

25. **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.

26. **Lump Sum.** The total price of a group of items which is priced as a whole.

27. **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.

28. **Modification.** Any authorized written order the Contract Administrator issued for a minor change in the Work and shall be synonymous with Field Orders and/or Field Modifications.

29. **Notice to Proceed.** Written notice instructing the Contractor to proceed with the Work.

30. **Observer.** The Observer is an appointed agent of the Contract Administrator to inspect (or observe) all work done. The Observer is appointed for the benefit of the City and any inspections shall be for the benefit of the City.

31. **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.

32. **Project.** The total construction related to the Work provided by this Contract. The Project may include construction by the City or by separate contractors.

33. **Proposal.** The properly signed written (or electronic if authorized) offer of the Bidder to perform all the work.

34. **Retainage.** The amount of monies held by the City until the contract is successfully completed.

35. **Right-of-Way.** Land, property, or interest therein devoted to or acquired for the purposes of public roads or utilities.

36. **Site Supervisor**. Person s at the location of the work responsible for dircting such work in the Public Right of Way. The Department Director shall be responsible for the certification procedure necessary to approve personnel to supervise work in the Public Right of Way.

37. **Special Provisions.** Additions to or modifications of the standard specifications and supplemental specifications covering conditions peculiar to the work.

38. **Specifications.** Any written requirement for materials, equipment, construction systems, standards or workmanship for the Work, including performance of related services.

39. **Standard Specifications.** The officially adopted Standard Specifications City of Lincoln, Nebraska.

40. **Subcontractor.** An individual, entity, firm, partnership, or corporation to whom the Contractor sublets a portion of the work.

41. **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.

42. **Substantial Completion** shall mean the stage when the City 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.

43. **Supplemental Specifications.** Specifications adopted subsequent to publication of the standard specifications which may add to, delete, or modify the standard specifications.

44. **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 therefrom.

45. **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.

46. **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.

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 in writing, the Contract Administrator 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 Contract Administrator 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 ten (10) 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.

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 ten (10) calendar 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 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 specially 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 Contract Administrator any conflicts between various parts of the Contract Documents, or questions pertaining to procedures, traffic control or material, for determination.

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, supercede the specifications.

If the plans and specifications should be found to be contradictory in any part, the plans 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 Contract Administrator and the Contract Administrator's decision thereon shall be final. Correction of errors or omissions on the drawings or specifications may be made by the Contract Administrator when such correction is necessary for the proper execution of the work.

The Contract Administrator will furnish the Contractor, free of charge, up to five (5) original-size copies of drawings and specifications that the Contract Administrator deems necessary to carry out the work. The Contractor may purchase additional copies.

The Contractor may be furnished additional instructions and detail drawings by the Contract Administrator 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.

B. EXTRA WORK

In the event portions of such Work are determined by the Contract Administrator 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 Contract Administrator.

Extra work shall be paid for as determined by the Contract Administrator 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 Contract Administrator and 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 Contract Administrator 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 fourteen (14) 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 Contract Administrator. The request for such minor changes shall be documented in writing by the Contract Administrator. 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 change order executed by the Mayor.

D. ROCK EXCAVATION

Rock Excavation shall be excavation in solid rock formations in the original bed or well defined ledges more than twelve inches in thickness, or detached solid masses of stone more than one-half (½) 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, no payment will be made for "Rock Excavation." The additional cost of rock excavation shall normally be considered subsidiary to and a part of the applicable Contract bid price.

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 Contract Administrator 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 and surplus materials 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 three (3) days of written notice from the Contract Administrator.

G. STAKES AND MONUMENTS

The Contractor must carefully preserve bench marks, reference points, and stakes set by the Contract Administrator, and in case of their damage or destruction, the Contractor will be charged with the expense of their replacement, and he shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance. In the case of any permanent monuments or bench marks which 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, and in case of damage or destruction, he will be charged with the expense of their replacement.

H. 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 Contract Administrator for the Contractor to carry on his work.

I. OWNERSHIP OF SALVAGED MATERIALS

Materials removed and salvaged in accordance with the plans, or as directed by the Contract Administrator, 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 Contract Administrator. 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 Contract Administrator. The Contractor shall furnish salvage receipts to the Contract Administrator if required by these specifications.

J. BORROW AND WASTE SITES

Unless borrow or waste sites are designated on the plans or specified in the special provisions, the Contractor shall select the site and the Contract Administrator shall approve the locations of such sites. These sites will be maintained by the contractor at no cost to the City.

IV. CONTROL OF MATERIALS

A. MATERIAL STORAGE

The Contractor shall store all material under the general supervision and direction of the Contract Administrator.

The Contractor shall store all Materials to preserve their quality and fitness for the Work and to facilitate inspection.

The Contract Administrator may, when needed, order the Contractor to store Materials under cover or on platforms or as the Contract Administrator 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 Contract Administrator.

B. TESTS AND SAMPLES

The Contractor shall furnish, at no expense to the City, such samples of materials as may be required by the Contract Administrator 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.

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 Contract Administrator 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 Contract Administrator 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 Contract Administrator.

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

D. ALTERATIONS AND SUBSTITUTIONS

The Contract Administrator 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 Contract Administrator 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 Contract Administrator approves such request for substitution in writing. Upon any substitution of lesser priced goods, the Contract Administrator 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 effect major changes in the function or general design.

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 Contract Administrator.

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: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby; and (iii) notify the Contract Administrator, AND any regulatory agency required by law. The Contract Administrator 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 THE CONTRACT ADMINISTRATOR

The Contract Administrator in this Contract is acting as an agent of the City during the construction period. The Contract Administrator shall decide questions which may arise as to quality and acceptability of materials furnished and work performed. The Contractor will be held strictly to the intent of the Contract Documents in regard to the quality materials, workmanship, and execution of the work. Inspections may be made at the factory or fabrication plant of the source of material supply.

The Contract Administrator will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety, except that those procedures specifically called for in the Contract Documents shall be strictly followed.

The Contract Administrator shall decide all questions which may arise as to Contract fulfillment on the part of the Contractor and the Contract Administrator'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 Contract Administrator 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 Contract Administrator deems necessary.

B. AUTHORITY OF THE OBSERVER

The Observer is an appointed agent of the Contract Administrator to inspect all work done. The Observer will keep the Contract Administrator 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 Observer will not be authorized to revoke, alter, enlarge, or relax the provisions of these specifications. The Observer is appointed for the benefit of the City and any inspections shall be for the benefit of the City. The presence of the Observer shall not be used or construed as a waiver of any of the Contractor's obligations pursuant to the contract. Failure of an Observer 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.

1. The Observer 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 Contract Administrator is notified and decides the questions at issue.

2. The Observer 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.

C. PRE-CONSTRUCTION AND PROGRESS CONFERENCE

Upon receipt of notification from the Contract Administrator, the Contractor or the Contractor's authorized representative shall, at no cost to the City, appear at a location and time designated by the Contract Administrator for the purpose of discussing pre-construction scheduling, traffic control procedure or methods, and project progress during construction. 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 Contract Administrator.

D. 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 Traffic Operations Section at least forty-eight (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.

E. 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 Contract Administrator.

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 Contract Administrator's services and expenses.

If a portion of the Work has been covered that the Contract Administrator has not specifically requested to observe prior to its being covered, the Contract Administrator 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.

F. CORRECTING WORK

The Contractor shall promptly correct Work rejected by the Contract Administrator 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 Contract Administrator'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 Contract Administrator, 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 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 Contract Administrator'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 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 Contractor shall reduce the Contract Sum as appropriate and equitable. The City and 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 days from such adjustment.

G. 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.

H. SHOP DRAWINGS

The Contractor, as soon as possible, shall submit to the Contract Administrator 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 Contract Administrator'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 Contract Administrator 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.

At least three (3) final copies of all shop or setting drawings shall be submitted to the Contract Administrator, who, after checking, will retain two (2) copies and return the other copy to the Contractor. The Contract Administrator'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 Contract Administrator. 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 Contract Administrator will not relieve the Contractor of any responsibility for the proper performance or functioning of the completed project.

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

I. OTHER CONTRACTS

The City may require the Contractor to coordinate with other contractors at or near the Work site.

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 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 to injury to or destruction of tangible property, including the loss of use resulting therefrom 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 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.

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, 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.

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 Contract Administrator. 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.

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.

L. ASSIGNMENT OF CONTRACTS

No assignment by the Contractor of any contract, or any part thereof, or of the funds to be received thereunder 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 Contract Administrator 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.

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 Contract Administrator 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 twelve (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.

R. EXECUTIVE ORDERS

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 Public Works 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, 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.

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 therefor. 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.

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 Contract Administrator.

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

VII. PROSECUTION AND PROGRESS OF WORK

A. NOTIFICATION

The Contractor shall keep the Contract Administrator informed, forty-eight (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 Contract Administrator 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 Contract Administrator at least forty-eight (48) hours in advance unless otherwise approved by the Contract Administrator.

For any work that requires construction within the public right-of-way, forty-eight (48) hours advance notice shall be given to the Contract Administrator and the City Traffic Engineer. For any work that requires closing of any portion of a street, permission shall be obtained from the City Traffic Engineer, with copies provided to the Contract Administrator.

Street reconstruction, excavation, or maintenance work which may involve the parking metered district may involve the use of the metered parking stall space will require that the meter be hooded or removed by the Traffic Engineer. The Contractor shall give at least forty-eight (48) hours advance notice of the date and time to the City Traffic Engineer.

The Contractor is responsible for notifying the City Testing Lab to arrange for any necessary testing in advance of contemplated work. The Contractor shall give at least forty-eight (48) hours advance notice of the date and time to the City Testing Lab.

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 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 Contract Administrator.

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.

D. SUPERVISION AND DISCIPLINE BY CONTRACTOR

The Contractor shall supervise and direct the Work, using the Contractor's 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 Contractor.

E. EXTENSION OF TIME

The time for completion of the work may be extended upon written request from the Contractor to the Contract Administrator, 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, or to fires, floods, labor disputes, epidemics, abnormal weather conditions or acts of God; or the request is based upon a change in the scope of the work which has been approved by the Contract Administrator. The length of such extension, if approved by the Contract Administrator, 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 twenty (20) 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.

F. LIQUIDATED DAMAGES

If the Contractor fails to timely complete the Work 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 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.

G. 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, seven 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.

3. If the Contract is terminated by City as provided in this section, Contractor shall not be entitled to receive any further payment until the expiration of 35 days after Final Completion and acceptance of all Work by 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 Contractor. If such costs, expenses, losses, and liquidated damages exceed the unpaid balance of the Contract Sum, Contractor shall pay such excess to 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 City after termination shall prejudice any other rights or remedies of City provided by law or by the Contract Documents upon such termination; and City may proceed against Contractor to recover all losses suffered by City.

H. 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 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;

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, City shall pay to Contractor the sum of the following:

a. The amount of the Contract Sum allocable to the portion of the Work properly performed by Contractor as of the date of termination, less sums previously paid to Contractor.

b. Previously unpaid costs of any items delivered to the Project site which were 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 Contractor is entitled in the event of termination of the Contract by City pursuant to this provision; and Contractor will be entitled to no other compensation or damages and expressly waives same.

I. CLAIMS & DISPUTES

The Contractor and City shall make any Claim against the other party in writing giving a description thereof. The claimant may make a Claim only within twenty-one (21) days after occurrence of the event giving rise to such Claim or within twenty-

one (21) 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.

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 the 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 Contract Administrator 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 twenty-one (21) 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 Contract Administrator, (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 Contract Administrator, (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 twenty-one (21) 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.

J. RESOLUTION OF CLAIMS AND DISPUTES

The Contract Administrator shall review Claims and take one or more of the following preliminary actions within ten days after receipt of a Claim: (1) request additional supporting data from the Claimant, (2) submit a schedule to the parties indicating when the Contract Administrator 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 Contract Administrator may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

If the City and Contractor resolve the Claim, the Contract Administrator shall prepare a Change Order or other documentation accordingly.

If the City and 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

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 two (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 two-year (2) guarantee period, structures, all backfilled trenches and all sidewalks, pavement, and driveways judged by the Contract Administrator 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 two (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 two (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 Contract Administrator.

4. Portland Cement Concrete Pavement

The Contractor guarantees all paving construction against defects in materials or workmanship for a period of two (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 concrete weld material that has a similar color as the concrete. 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 Contract Administrator.

5. Procedure

During such guarantee period, if the City discovers that any of the Work is not in accordance with the Contract Documents, the City shall notify the Contractor in writing. The City shall give such notice promptly after discovery of the condition. Upon such notice, the Contractor shall promptly correct the work, at the Contractor’s expense. The Contractor shall extend the guarantee period for any portions of Work first performed after Substantial Completion. The Contractor shall extend the guarantee period for the number of days between Substantial Completion and the actual completion of such Work. All obligations shall survive acceptance of the Work under the Contract and termination of the Contract.

If at any time within the period of guarantee, any of the Work included in the guarantee shall require any repair or reconstruction, the Contract Administrator 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 Contract Administrator, 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 Contract Administrator in writing within thirty (30) 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 thirty (30) days' notice must be served upon the Contract Administrator 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 Contract Administrator 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 Contract Administrator shall make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Contract Administrator'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 Contract Administrator's written notification. Once corrected or completed, the Contractor may submit a request to the Contract Administrator for another inspection to determine Substantial Completion.

When the Work or designated portion thereof is substantially complete, the Contract Administrator 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 Contract Administrator 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 Contract Administrator'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 under and the requirements of the Contract Documents shall be deemed as having been fulfilled and met when the work is accepted by the City by formal action of the Contract Administrator 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 Contract Administrator 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 Contract Administrator 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 Contract Administrator 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, ninety-five percent (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 judgement of the Contract Administrator, 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 Contract Administrator in advance of project completion. Consideration will be given to time frames of work completion in relationship to the total work.

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 Contract Administrator.

If the Contract Administrator certifies the project is substantially complete and provided a final payment will be delayed more than sixty (60) days because of project complexities or the determination of final costs and quantities, the Contract Administrator may authorize payment in an amount not to exceed ninety-nine percent (99%) of the value of the work performed.

E. FINAL PAYMENT

1. Lump Sum Contracts.

   The Contract Administrator 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 Contract Administrator shall have final measurements made to 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 Contractor against the City.

IX. MISCELLANEOUS

A. MOBILIZATION

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.

Basis of Payment:

No measurement is required. Fifty percent 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 twenty percent of the value of the work has been completed. The bid amount for mobilization cannot exceed ten percent of the total bid amount (including mobilization).

B. CONSTRUCTION STAKING

Unless otherwise specified, the scope of Construction Staking when listed with the items for bid is as follows:

The City will provide horizontal and vertical control points as shown on the plans for the Contractors use in establishing the exact location and elevations for the project. The Contractor shall be responsible for preserving (or reestablishing) 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 accordance with the details shown on the plans. Contractor shall follow the current Lincoln Standard Plan.

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.

The Contractor's staking records shall be recorded in a format approved by the City and submitted to the City at the completion of the project. Record notebooks and electronic data, in a format acceptable by the City, will be submitted to the City at the completion of the project.

Basis for payment:

Construction staking shall not be measured, but shall be paid for at the Contract Lump Sum amount bid 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.

C. 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.

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 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 one percent (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 ninety (90) days) from presentation of the City's findings to Contractor.

D. 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 Contract Administrator to evaluate the progress of the Work by 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 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 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 fo 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

Chapter 1

PAVEMENT CONSTRUCTION & RECONSTRUCTION

ARTICLE	TITLE
1.00	General
1.01	Related Items Specified Elsewhere
1.02	Materials
1.03	Pavement Construction A. Asphaltic Concrete Pavement, Class 1 B. Asphaltic Concrete Pavement, Class 2 C. Portland Cement Concrete Pavement D. Portland Cement Concrete Pavement with Integral Curb
1.04	Pavement Reconstruction A. Pavement and Sidewalk Removal B. Replacement of Pavement, Driveways, & Sidewalks
1.05	Appurtenances and Miscellaneous A. Field Adjustments B. Culvert Removal C. Survey Monument Boxes D. Dead End Barricade, Type III E. Ground Sleeves F. Construction Over New Sewers
1.06	Hot/Cold Weather Construction A. Concrete Construction - Hot Weather B. Cold Weather Construction C. Winter Construction
1.07	Substantial Completion

CHAPTER 1

PAVEMENT CONSTRUCTION & RECONSTRUCTION

1.00 GENERAL

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 Specifications and the lines, grades and cross sections shown on the plans, all as directed by the Engineer.

1.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 2	Earthwork
Chapter 3	Portland Cement Concrete Pavement
Chapter 4	Portland Cement Concrete Base
Chapter 5	Asphaltic Concrete Construction
Chapter 6	Portland Cement Concrete Curbs and Median Construction
Chapter 7	Sidewalk and Driveways
Chapter 8	Retaining Walls and Steps
Chapter 11	Portland Cement Concrete
Chapter 12	Asphaltic Concrete
Chapter 13	Traffic Pavement Marking

1.02 MATERIALS

All materials used in pavement construction and reconstruction shall be on the latest edition of the Nebraska Department of Roads “Approved Products List” unless otherwise approved by the Engineer.

1.03 PAVEMENT CONSTRUCTION

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

A. ASPHALTIC CONCRETE PAVEMENT, CLASS 1

Asphaltic Concrete Pavement, Class 1, shall consist of an asphaltic concrete wearing surface placed on a Portland Cement Concrete base. The wearing surface shall be of a type of asphaltic concrete which meets the Mix Design and Aggregate Criteria specifications as shown in Chapter 12, unless otherwise specified. The thickness shall be 2 ½ inches unless otherwise shown on the plans. The Portland Cement Concrete base shall be class LB-2750 concrete, as defined in Chapter 11, 5" in thickness unless otherwise shown on the plans.

1.03 PAVEMENT CONSTRUCTION (Continued)

B. ASPHALTIC CONCRETE PAVEMENT, CLASS 2

Asphaltic Concrete Pavement, Class 2, shall consist of an asphaltic concrete wearing surface placed on an asphaltic concrete base. The wearing surface and the base shall be of a type of asphaltic concrete which meets the Mix Design and Aggregate Criteria specifications as shown in Chapter 12, unless otherwise specified, and shall be of the total pavement thickness as shown on the plans. Lift thickness of the base shall be between 3 inches and 5 inches after compaction to required density. All subsequent lifts shall be between 1 inch and 3 inches after compaction to required density.

C. PORTLAND CEMENT CONCRETE PAVEMENT

Portland Cement Concrete Pavement shall be class L-3500 concrete, as defined in Chapter 11, of the thickness, and with or without reinforcement, as shown on the plans unless otherwise specified.

D. PORTLAND CEMENT CONCRETE PAVEMENT WITH INTEGRAL CURB

Portland Cement Concrete Pavement with Integral Curb shall consist of L-3500 concrete of the thickness and with or without reinforcement, as shown on the plans.

BASIS OF PAYMENT

The item "PAVEMENT" shall be one of the following: Asphaltic Concrete Pavement, Class 1; Asphaltic Concrete Pavement, Class 2; Portland Cement Concrete Pavement; or Portland Cement Concrete Pavement with Integral Curb. The pavement of the dimensions called for on the plans, constructed in conformance with the Lincoln Standard Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price per square yard for PAVEMENT. The final measure shall be for pavement only, excluding curb and gutter, except for pavement with integral curb where the final measure shall be from back of curb to back of curb. Such payment shall be full compensation for all preparation of sub-grade, 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.

1.04 PAVEMENT RECONSTRUCTION

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.

Unless otherwise specified, all Portland Cement Concrete for use in Pavement Reconstruction, including base reconstruction, shall be class L-3500 as described in Chapter 11 of these specifications. Asphaltic Concrete for use as surface courses and base courses shall meet the requirements of Chapters 5 and 12 of these specifications.

1.04 PAVEMENT RECONSTRUCTION (Continued)

A. PAVEMENT AND SIDEWALK REMOVAL

The Engineer 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 Engineer, 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 Engineer. 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 Engineer will order further removal at the Contractor's expense. Pavement which is removed without authorization by the Engineer shall be replaced at the Contractor's expense.

TYPE "A" SAWING - 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 inch 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.

TYPE "B" SAWING - Portland cement concrete 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.

TYPE "C" SAWING - Portland cement concrete driveways and sidewalks to be removed shall be isolated from the driveway and sidewalk to remain by cutting a full depth saw cut.

TYPE "D" SAWING - 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.

WHEEL SAWING - 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.

BASIS OF PAYMENT

REMOVAL

When called for in the proposal, pavement, sidewalk, driveway, curb, steps, retaining wall and miscellaneous masonry item removal accomplished in accordance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per cubic yard for PAVEMENT AND SIDEWALK REMOVAL. Measurement shall be made on a solid cubic yard basis prior to 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.

TYPE "A" SAWING

When called for in the proposal, sawing asphaltic concrete with a wheel saw, completed in conformance with these Specifications and accepted by the Engineer 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 inch strip of asphalt, including all equipment, tools, labor, and incidentals necessary to complete this type of work.

TYPE "B" SAWING

When called for in the proposal, sawing portland cement concrete pavement, completed in conformance with these Specifications and accepted by the Engineer 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, including all equipment, tools, labor, materials, and incidentals necessary to complete this item of work.

TYPE "C" SAWING

When called for in the proposal, sawing portland cement concrete driveways and sidewalks, completed in conformance with these Specifications and accepted by the Engineer 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, including all equipment, tools, labor, materials, and incidentals necessary to complete this item of work.

TYPE "D" SAWING

When called for in the proposal, sawing asphaltic concrete surface course, completed in conformance with the Specifications and accepted by the Engineer 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.

WHEEL SAWING

When called for in the proposal, sawing pavement with a wheel saw, completed in conformance with the Specifications and accepted by the Engineer 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, including all equipment, tools, labor, materials, and incidentals necessary to complete this item of work.

B. REPLACEMENT OF PAVEMENT, DRIVEWAYS, AND SIDEWALKS

All pavement, driveways and sidewalks to be replaced or reconstructed under each contract shall be placed at the locations shown on the plans, directed by the Engineer, and in accordance with these Specifications.

BASIS OF PAYMENT

REMOVAL AND REPLACEMENT (BY AREA)

When called for in the proposal, the removal and replacement of pavement, curb and gutter, curb, sidewalk and driveway completed in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per square yard for PAVEMENT REMOVAL AND REPLACEMENT, per square foot for DRIVEWAY REMOVAL AND REPLACEMENT, and SIDEWALK REMOVAL AND REPLACEMENT, and per linear foot for CURB REMOVAL AND REPLACEMENT, and CURB AND GUTTER REMOVAL AND REPLACEMENT. Such payment shall be full compensation for removal of the existing items and their disposal, preparation of new subgrades, constructing the replacement items, materials, equipment, tools, labor, and incidentals necessary to complete the removal and replacement of each item called for in the Contract Documents.

REPLACEMENT OF PAVING ITEMS

When called for in the proposal, portland cement concrete curbs, curb and gutter, sidewalk, driveway, and other pavement items replaced in conformance with these Specifications and accepted by the Engineer shall be measured and paid for as provided in the appropriate technical chapters, provided they are not specified as removal and replacement items as identified previously for payment.

When called for in the proposal and not identified as a removal and replacement item, asphaltic concrete pavement reconstructed in accordance with these Specifications and accepted by the Engineer shall be measured and paid for as follows:

1. The replacement of portland cement concrete base shall be measured and paid for at the contract unit price bid, per square yard for CONCRETE BASE, ____ inches thick, for each thickness identified in the proposal. Such payment shall be full compensation for preparation of the abutting pavement surfaces, subgrade preparation, forms if required, curing, jointing, materials, equipment, tools, labor, and incidentals necessary to replace the base ready 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 Engineer, would not have had to be removed to perform the work.

2. The replacement of asphaltic concrete surface courses of the various types called for shall be paid for at the contract unit price bid per ton for ASPHALTIC CONCRETE SURFACE COURSE, TYPE ___. The amount of asphaltic concrete to be paid for shall be the tare weight of the material actually incorporated into the work. Such payment shall be full compensation for all mixing, hauling, tack coats, spreading, compacting, materials, equipment, tools, labor, and incidentals necessary to construct the asphaltic concrete surface course to the thickness designated on the plan or as directed by the Engineer.

1.05 APPURTENANCES AND MISCELLANEOUS

A. FIELD ADJUSTMENTS

1. 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 Engineer. 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 Engineer, cannot be temporarily relocated, shall be delivered to the owner.

Removal, relocation, and resetting of mail boxes or storage and resetting of mail boxes, completed in conformance with these Specifications and accepted by the Engineer, 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.

2. Manholes

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 Engineer.

BASIS OF PAYMENT

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

3. Inlets

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 Engineer.

BASIS OF PAYMENT

Inlets adjusted to grade in conformance with these Specifications and accepted by the Engineer, shall be counted and paid for at the contract unit price bid per each for ADJUST INLET TO GRADE, COMPLETE. Such payment shall be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

4. Water Valve Boxes and Water Stop Boxes

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 Engineer.

BASIS OF PAYMENT

Water valve and stop boxes adjusted to grade in accordance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid per each for ADJUST WATER VALVE BOX TO GRADE, COMPLETE. 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.

B. CULVERT REMOVAL

Driveway and roadway culverts shall be removed and stored at a location on the project site designated by the Engineer. Culverts which are not claimed by the respective property owners and which have a salvage value, as determined by the Engineer, 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.

C. SURVEY MONUMENT BOXES

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 wells, or that has been plugged or filled.

The Contractor shall install survey monument boxes at all points shown on the plans, regardless of the type of pavement installed. All monument boxes shall be placed after the paving is completed by use of a concrete coring machine equipped with a 7 inch O.D. bit. Exact location shall be marked by the Engineer.

After placement of the box, the interior shall be filled to the bottom of the lid support shoulders with sand or sand and gravel as shown on the drawings.

The Contractor is responsible for placement of the monument box only. Monuments shall be placed by others.

BASIS OF PAYMENT

Monument boxes placed in accordance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid per each for STANDARD MONUMENT BOX, IN PLACE. Such payment shall be full compensation for all materials, equipment, tools, labor, and incidentals necessary to complete the work.

D. DEAD END BARRICADE, TYPE III

The Contractor shall install dead end barricades, Type III at all points shown on the plans or at all locations directed by the Engineer.

The dead end barricades, Type III shall not be installed until such time as all grading and pavement construction has been completed.

The Contractor shall remove dead end barricades at all points shown on the plans or at all locations directed by the Engineer.

The Contractor shall remove and reset dead end barricades at all points shown on the plans or at all locations directed by the Engineer.

BASIS OF PAYMENT

Dead end barricades installed to the full width of the adjoint pavement in conformance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid per each STANDARD DEAD END BARRICADE, TYPE III, IN PLACE, regardless of width. Such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to complete the work.

Dead end barricades removed in conformance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price per each for REMOVE STANDARD DEAD END BARRICADE, regardless of width. Such payment shall be full compensation of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Dead end barricades removed and reset in conformance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price per each for REMOVE AND RESET STANDARD DEAD END BARRICADE. Such payment shall be full compensation of all materials, equipment, tools, labor and incidentals necessary to complete the work.

1.05 APPURTENANCES AND MISCELLANEOUS (Continued)

E. GROUND SLEEVES

The Contractor shall install ground sleeves for sign posts, as described in Section 14.03, Paragraphs D and E of these specifications in all medians shown on the plans or as directed by the Engineer.

F. 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.

1.06 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 1.06), the following precautions shall be taken:

1. Dampen subgrade and forms.
2. Dampen aggregates prior to mixing.
3. Maintain cool aggregates and mixing water.
4. Finish immediately following placement.
5. Cure immediately following finishing operation.
6. Trucks must be discharged within one hour after loading (agitation shall be minimized).

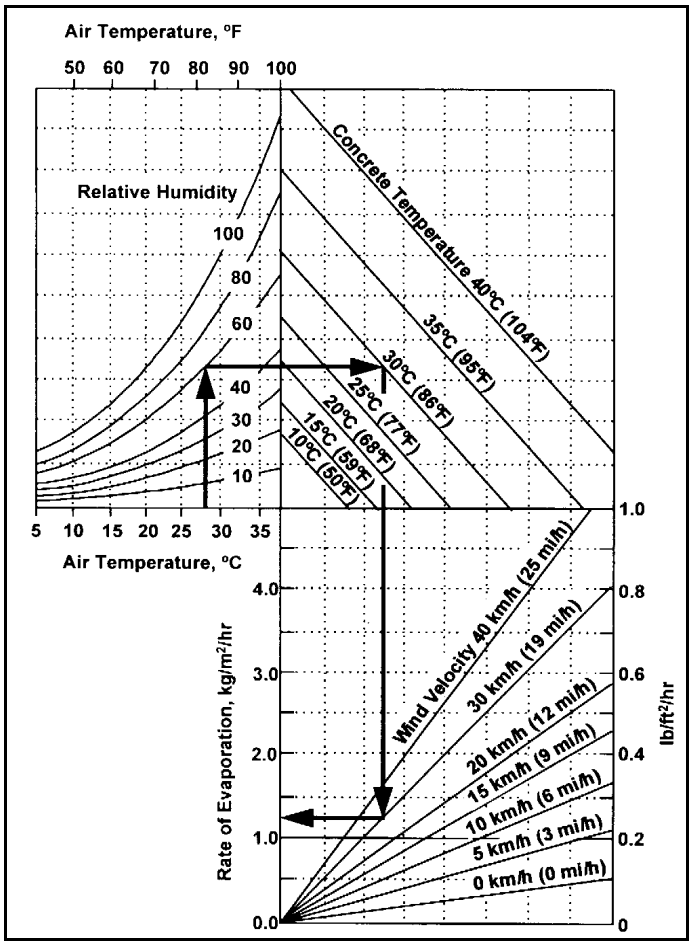

Figure 1.06
HOT WEATHER CONCRETING EVAPORATION NOMOGRAPH

B. COLD WEATHER CONSTRUCTION

1. Concrete

Concrete shall not be placed in inclement weather except with permission of the 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 and it shall be maintained for seventy-two (72) hours at a minimum of 50°F with adequate layers of burlap, plastic, insulated blankets, or other approved materials.

1.06 HOT/COLD WEATHER CONSTRUCTION (Continued)

1. Concrete (Continued)

   The concrete further shall have achieved the minimum design strength desired prior to any vehicular use of the section, as determined by the Engineer. Concrete construction during cold weather shall be continued only with the specific authorization of the Engineer, who may require special construction methods.

2. Asphalt

   Control of the placement of asphaltic concrete mixture shall be determined as provided in Chapter 5 of the Specifications.

3. Fills and Embankments

   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.

C. WINTER CONSTRUCTION

Suspension of work during the winter construction period, November 1 to April 1, may be requested by the Contractor under the following conditions:

1. The request must be made in writing to the Engineer and shall include the beginning date and duration. If work is to be resumed prior to expiration of the time requested, a forty-eight (48) hour written notice of such intent shall 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 shall become effective.

3. Calendar days included in the period that work is actually suspended shall be counted from the effective suspension date, as provided in Item 2 above, 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 the Contract.

The Engineer 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 Engineer shall notify the Contractor, in writing, of the new completion date of the Contract, as provided above.

1.07 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 Engineer. Such items shall include but will not be limited to: curb and gutter, asphaltic concrete pavement/portland cement concrete 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 Engineer. However, the Contractor may submit a written request to the Engineer for approval to suspend such liquidated damages to allow additional time for completion of such minor items of the work as seeding, sodding, and survey monuments. Granting the request for additional time by the Engineer 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 2

EARTHWORK

ARTICLE	TITLE
2.00	General
2.01	Related Items Specified Elsewhere
2.02	General Clearing
	A. General Clearing & Grubbing B. Tree Removal C. Tree Transplant D. Remove & Replace Fence
2.03	Excavation
2.04	Disposal of Surplus Materials
2.05	Conservation of Topsoil
2.06	Embankment
2.07	Parking Space Finish
2.08	Preparation of Subgrade
2.09	Cold Weather Construction
2.10	Substantial Completion

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 Specifications, and to conform to the line, grade and cross section shown on the plans, or as directed by the Engineer.

2.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 31 Landscape Work

2.02 GENERAL CLEARING

A. GENERAL CLEARING AND GRUBBING

The necessary removal of all trees and stumps less than 12 inches in diameter, brush, roots, shrubs, trash, etc. within the limits of the project shall be as directed by the Engineer. The debris removed shall be disposed of at the location approved by the Engineer. No burning will be allowed at the site of the work.

Large roots shall be removed to a depth of at least 12 inches below natural ground, subgrade, or finish grade elevation as directed by the Engineer.

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 Specifications and accepted by the Engineer.

B. TREE REMOVAL

Trees 12 inches in diameter or greater, measured 24 inches above the ground, shall be removed from the site of the work together with their stumps and large roots. Existing stumps and stumps resulting from tree removal, together with large roots, shall be removed to a depth of at least 12 inches 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 accordance with these Specifications.

BASIS OF PAYMENT

Trees 12 inches in diameter and larger and their stumps, removed in conformance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per each for TREE REMOVAL (_____INCHES to _____INCHES) for the various sizes called for. 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 inches in diameter and larger, removed in accordance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per each for STUMP REMOVAL (_____INCHES [mm] to _____INCHES) 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.

C. TRANSPLANT TREE (SAPLINGS TO 6 INCHES)

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 Engineer 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 Engineer.

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.

BASIS OF PAYMENT

Trees which are transplanted in accordance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid each for TRANSPLANT TREE (SAPLINGS TO 6 INCHES). Such payment shall be full compensation for transplanting the tree, backfilling, supporting the tree, materials, tools, labor and incidentals necessary to complete the work.

D. REMOVE & REPLACE FENCE

Where indicated on the plans or in the Special Provisions, fences to be removed or replaced 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 the replacement 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.

2.02 GENERAL CLEARING (Continued)

BASIS OF PAYMENT

Fence removed and replaced using new or salvaged material, constructed in accordance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per linear foot for REMOVE AND REPLACE 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.

2.03 EXCAVATION

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 areas selected by the Contractor and approved by the Engineer.

When unsuitable material is encountered in the subgrade beyond the limits of the typical section, it shall be excavated as directed by the Engineer. The limits of such over-excavation shall be approved by the Engineer and the material removed from the subgrade, shall be hauled and deposited at a location approved by the Engineer. Additional suitable material shall be obtained by the Contractor and incorporated into the fill according to the compaction requirements specified in Section 2.07.

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 Section 2.07 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 Engineer 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 the Engineer has performed such soils sampling and testing as necessary of the proposed borrow material(s) to determine suitability based on compliance with all project requirements.

When so designated on the plans, borrow shall be taken from the designated areas in accordance with lines and grades furnished by the Engineer. 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.

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 Engineer, removal of unsuitable material, shall be measured and added to the established quantities as an EXTRA WORK item as described in Section III, Paragraph B, of the General Provisions and Requirements.

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.

2.04 DISPOSAL OF SURPLUS MATERIALS

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 such locations as directed by the Engineer. 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, whether placed on public or private property, shall be dumped, spread and finished to grades as designated.

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 which must be removed from the site and disposed of at a location approved by the Engineer. All such payments shall be full compensation for equipment, tools, labor and incidentals necessary to complete the work.

2.05 CONSERVATION OF TOP SOIL

Topsoil shall be carefully removed and deposited in storage piles at the job site or as directed by the Engineer 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.

2.06 EMBANKMENT

EMBANKMENT shall be defined as the raised soil structure of the roadway 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. Only when authorized by the Engineer, may thoroughly pulverized sod mixed with earth be deposited.

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 inches 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.2.07

Each successive layer of material placed as described shall be compacted by rolling to a density of not less than ninety-five percent (95%) 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 two percent (2%) below and four percent (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 Engineer, 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 Engineer.

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 Specifications and accepted by the Engineer.

2.07 PARKING SPACE FINISH

The parking space is hereby defined as that part of the street right-of-way within the limits of the work, exclusive of paved roadway 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 Engineer. In general, they shall be covered with a seed bed, 2 inches in thickness, of selected topsoil reserved for this purpose at the time grading 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".

BASIS OF PAYMENT

PARKING SPACE FINISH performed in conformance with the Specifications and accepted by the Engineer 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.

2.08 PREPARATION OF SUBGRADE

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 6" of the surface. 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 Engineer.

The subgrade for Portland Cement Concrete Pavement and Class I Asphaltic Concrete pavement shall be constructed to a uniform density of not less than ninety-five percent (95%) of the maximum density (as determined by AASHTO Standard Method T-99) throughout its entire width. The subgrade for Class II Asphaltic Concrete Pavement shall be constructed to a uniform density of not less than one hundred percent (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

2.08 PREPARATION OF SUBGRADE (Continued)

that it will be between two percent below (-2%) and four percent 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 6 inches 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.

Immediately prior to paving, the entire subgrade for concrete pavement must be thoroughly manipulated and recompacted 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 Engineer. 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 Engineer. No pavement or foundation material shall be placed on any subgrade before the same is accepted by the Engineer.

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 Engineer, 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.

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.

2.09 COLD WEATHER CONSTRUCTION

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. Earthwork shall be restricted as to time of the year and atmospheric temperature as stated in Section 1.06 of these Specifications.

2.10 SUBSTANTIAL COMPLETION

Earthwork items will be considered substantially complete when they meet the requirements of Section 1.07 of these Specifications.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 3

PORTLAND CEMENT CONCRETE PAVEMENT

ARTICLE	TITLE
3.00	General
3.01	Related Items Specified Elsewhere
3.02	Materials
	A. Concrete B. Reinforcement C. Reinforcing Bar Supports D. Metal Dowel or Expansion Bar Sleeve E. Preformed Expansion Joint Material F. Joint Sealer G. Curing Compounds H. Metal Keyway
3.03	Preparation of the Subgrade
3.04	Forms
	A. Rigid Forms B. Slip Forms
3.05	Placing Reinforcing Steel
3.06	Concrete Placement
	A. Vibrating B. Finishing
3.07	Joints
	A. Transverse Construction Joints B. Expansion Joints C. Contraction Joints or Planes of Weakness D. Joint Sealing
3.08	Curing and Protection
	A. Curing B. Protection
3.09	Basis of Payment
3.10	Integral Curb

ARTICLE	TITLE
3.11	Alley Pavement & Alley Returns
3.12	Hot & Cold Weather Construction
3.13	Substantial Completion

CHAPTER 3

PORTLAND CEMENT CONCRETE PAVEMENT

3.00 GENERAL

Portland cement concrete pavement shall be constructed of the materials as herein specified, on an approved subgrade, in accordance with these Specifications and in conformity with the lines, grades, typical cross section, and details shown on the plans.

3.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1	Pavement Construction & Reconstruction
Chapter 2	Earthwork
Chapter 11	Portland Cement Concrete

3.02 MATERIALS

A. CONCRETE

Unless otherwise specified all Concrete shall be L-3500 as described in Chapter 11 of these Specifications.

B. REINFORCEMENT

All reinforcement bars shown on the plans 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) and shall be free from rust, scale or other substances.

Smooth dowel bars shall be epoxy coated and conform to the requirements of "Structural Steel", ASTM A 36.

Welded steel fabric shall consist of sheets or strips manufactured for the purpose. The fabric shall comply with the "Standard Specifications for Steel Welded Wire Reinforcement Plain for Concrete", ASTM A 185. Intersecting members shall be rigidly welded at right angles in such a manner as to develop the full tensile strength across the weld. Steel fabric is specified on the plans by gauge and spacing of wires. The gauge number specified shall be in accordance with the above reference.

C. REINFORCING BAR SUPPORTS

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

3.02 MATERIALS (Continued)

D. METAL DOWEL OR EXPANSION BAR SLEEVE

Metal or plastic sleeves for dowel or expansion bars shall be satisfactory to the Engineer 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

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 inch thick unless otherwise specified.

F. JOINT SEALER

The joint sealer shall conform to the requirements of "Standard Specification for Joint Sealants, Hot applied, for Concrete and Asphalt Pavements", ASTM Designation D 3405.

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 NDOR Approved Products list shall be used unless otherwise approved by the 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.

H. METAL KEYWAY

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

3.03 PREPARATION OF SUBGRADE

The subgrade shall be prepared as specified in Chapter 2 of these 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.

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.

3.04 FORMS

A. RIGID FORMS

Forms shall be of an approved steel section with a minimum base width of 6 inches and shall have adequate locking devices. The forms shall have a minimum length of 10 feet . On curves having a radius of less than 150 feet, approved wood 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 Engineer.

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 feet ahead of the paving operation.

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

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.

B. SLIP FORMS

Slip form equipment shall be provided with traveling side forms 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 which operate from an offset control line. The line and grade of the slip form equipment shall be automatically controlled.

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.

3.05 PLACING REINFORCING STEEL

Reinforcement shall be placed as shown on the plans or Lincoln Standard Plans.

All reinforcing steel shall be kept clean and free from foreign material that will prevent the proper bond with the concrete. Welded wire fabric and welded bar mats shall be furnished in flat sheets and shall be handled carefully during the placing and kept straight until installed.

3.05 PLACING REINFORCING STEEL (Continued)

The reinforcement shall be placed so that the outside longitudinal members will be located no more than 3 inches from the edge of the slab section and the ends of all longitudinal members shall extend to within 2 inches of the ends of the slab sections. Adjacent sheets of welded wire fabric shall be lapped not less than one mesh. The wire fabric shall be tied at all laps. All steel reinforcing bars shall be tied securely in place at all points where the bars cross.

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

3.06 CONCRETE PLACEMENT

The concrete shall be deposited uniformly on the prepared subgrades and distributed to the required depth for the entire width of the pavement by shoveling or other approved methods, struck off and finished, as hereinafter provided. Rakes shall not be used in handling concrete.

A. VIBRATING

All concrete shall be thoroughly compacted by means of approved mechanical vibrators. 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 concrete shall be well consolidated against the forms. At the end of the day, or in case of an unavoidable interruption of more than thirty (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.

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.

B. FINISHING

All equipment used for finishing shall meet the approval of the Engineer. Unless otherwise provided in the Special Provisions or approved by the Engineer, hand finishing as described herein may be employed only in cases of emergency and where mechanical methods are impractical.

1. 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 Engineer. The finish machine shall be operated over the entire width of the pavement section and shall achieve uniform consolidation.

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 tops of the forms and 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.

After the final pass of the finishing machine, the surface shall be checked and corrected by using approved 10 feet 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 one-half (½) its length on each successive position.

The Contractor shall furnish and keep in a convenient place a master straight edge, made of 6 inches 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.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. 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. 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.

2. 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 inches, the concrete shall be consolidated with an approved mechanical vibrator before the concrete is struck off.

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.

3. General Finishing

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 inch. 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.

Upon removal of the forms, all honeycombed areas or small defects shall be properly pointed up with 1:2 mix grout and the concrete previously protected by the forms shall be cured as hereinafter specified or as directed by the Engineer.

4. Surface Tests

After the pavement has been set sufficiently to permit foot traffic, the slab will be thoroughly checked by the Engineer or observer. All variations in excess of 1/8 inch, measured from the surface of the concrete in place with a 10 foot 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 Engineer, damage the pavement.

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.

3.07 JOINTS

A. TRANSVERSE CONSTRUCTION JOINTS

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 inch 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 roadway. 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 feet . 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.

B. EXPANSION JOINTS

1. Transverse

When transverse expansion joints are indicated on the plans, they shall be constructed at the location and in accordance with details shown in the plans or Lincoln Standard Plans. The joint material shall extend entirely through the pavement and shall be placed so the top edge will be 3/8 inch 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 Engineer. 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 foot 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 inch 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 accordance with details shown on the plans or as directed by the Engineer. Maximum joint spacing shall be 15 feet unless otherwise directed by the Engineer.

3.07 JOINTS (Continued)

C. CONTRACTION JOINTS OR PLANES OF WEAKNESS (Continued)

All joints shall be made with a motor driven concrete saw to a minimum depth of one-fourth (1/4) the pavement thickness. The sawing shall be accomplished not later than forty-eight (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 twenty-four (24) hours after concrete placement. Transverse contraction joints generally shall be sawed within eighteen (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.

Cracks developing before sawing commences or cracks developing ahead of the saw shall be routed to a depth of 3/8 inch by 3/8 inch in width. The joint between the curb and gutter section and concrete pavement shall be sawed to a depth of 1 inch and sealed.

D. JOINT SEALING

All expansion and saws joints shall be sealed as provided herein.

As soon as the joints are sawed and before traffic is allowed on the pavement, the joint shall be thoroughly cleaned by abrasive blasting or other approved means to remove all mortar, laitence, scale, dirt, dust, oil, curing compounds and other foreign material.

The joint shall be blown out with high pressure compressed air to remove all residue.

The joint shall be filled from the bottom to the top without formation of voids. The top of the finished joint seal shall be between 1/4 inch and 3/8 inch below the finished surface, unless shown otherwise on the plans.

At the time of application of the joint sealant, the joint and pavement shall be dry and acceptable to the Engineer. 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 twenty-four (24) hours.

The joint 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 Engineer 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 shall be filled as shown in the plans, through the use of pressure-type applicator, of a design approved by the Engineer and equipped with a nozzle which will fit into the joints.

3.07 JOINTS (Continued)

All adjoining surfaces shall be carefully protected during the joint 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 Engineer.

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.

3.08 CURING AND PROTECTION

A. CURING

1. Curing With Liquid Membrane Curing Compound

Immediately after the concrete has been finished, the concrete surface and exposed vertical edges shall be sealed with a uniform application of a membrane curing compound as described previously in this chapter. 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.

2. Curing With Wet Burlap

Immediately after the concrete has been finished, burlap shall be carefully placed on the concrete and kept moist in a manner which will not damage the pavement surface. 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 inches.

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, flares and, when required, watchmen to protect the new pavement and work site from vandalism and property destruction.

B. PROTECTION (Continued)

Any concrete showing injury from vandalism shall be repaired or removed and replaced at the Contractor's expense, to the Engineer'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 p.s.i. or seven (7) days have elapsed. A longer period of time may be required if, in the opinion of the Engineer, the concrete is not of sufficient strength to support the equipment or vehicles.

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.

3.09 BASIS OF PAYMENT

Reinforced concrete pavement of the various thicknesses called for in the proposal, constructed in conformance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per square yard for ___ INCH REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT. Such payment shall be full compensation for all subgrade preparation, form work, reinforcing steel, placing concrete, vibrating, finishing, jointing, sealing, curing, protection, headers, integral curbs if required, materials, equipment, tools, labor and incidentals necessary to complete the work.

Plain (non-reinforced) concrete pavement of the various thicknesses called for in the proposal, constructed in conformance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per square yard for ___ INCH PORTLAND CEMENT CONCRETE PAVEMENT. Such payment shall be full compensation for all subgrade preparation, form work, placing concrete, vibrating, finishing, jointing, sealing, curing, protection, headers, integral curbs if required, materials, equipment, tools, labor and incidentals necessary to complete the work.

3.10 INTEGRAL CURB

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.

When authorized by the Engineer, 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 Engineer.

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.

3.11 ALLEY PAVEMENT AND ALLEY RETURNS

The finishing of concrete alley pavement and concrete alley returns shall proceed, in general, in accordance 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, necessary modifications of the methods specified in this section will be approved by the Engineer. 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 foot therefrom, 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 specifications. All jointing, jointing patterns, and typical sections shall conform to Lincoln Standard Plans.

BASIS OF PAYMENT

Alley pavement of the various thicknesses called for in the proposals, constructed in conformance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per square yard for ___ INCH PORTLAND CEMENT CONCRETE ALLEY PAVEMENT. Such payment shall be full compensation for all subgrade preparation, form work, reinforcing steel if required, placing concrete, vibrating, finishing, jointing, sealing, curing, protection, materials, equipment, tools, labor and incidentals necessary to complete the work.

3.12 HOT AND COLD WEATHER CONSTRUCTION

Portland cement concrete paving work shall be accomplished only as provided in Section 1.06 of these Specifications.

3.13 SUBSTANTIAL COMPLETION

Paving construction will be considered substantially complete when it meets all of the requirements of Section 1.07 of these Specifications.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 4.00

PORTLAND CEMENT CONCRETE BASE

ARTICLE	TITLE
4.00	General
4.01	Related Items Specified Elsewhere
4.02	Materials
	A. Concrete B. Curing Compound
4.03	Preparation of the Subgrade
4.04	Forms
4.05	Concrete Placement
	A. General B. Vibrating C. Finishing
4.06	Joints
	A. Construction Joints B. Control Joints C. Longitudinal Construction Joints
4.07	Curing and Protection
	A. Curing B. Protection
4.08	Temporary Stop Plank
4.09	Cold Weather Construction
4.10	Substantial Completion

CHAPTER 4.00

PORTLAND CEMENT CONCRETE BASE

4.00 GENERAL

The concrete base shall be constructed on an approved subgrade in accordance with these Specifications, in conformity with the lines, grades and typical cross sections shown on the plans. The combined curb and gutter shall be used as side forms for the construction of the base, when appropriate.

4.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1	Pavement Construction & Reconstruction
Chapter 2	Earthwork
Chapter 11	Portland Cement Concrete

4.02 MATERIALS

A. CONCRETE

Concrete for new base pavement construction (Asphaltic Concrete Pavement, Class 1) shall be LB-2750 and concrete for replacement or repair of concrete base shall be L-3500 as described in Chapter 11 of these Specifications unless indicated otherwise on the Plans or Special Provisions.

B. 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 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 NDOR Approved Products list shall be used unless otherwise approved by the 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 NDOR Approved Products list shall be used unless otherwise approved by the Engineer.

4.03 PREPARATION OF SUBGRADE

The subgrade shall be prepared as specified in Chapter 2 of these 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.

4.04 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 six inches and a minimum length of ten feet, and shall be equipped with an adequate locking device. Wood forms may be used only on curves of less than 150 feet 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 feet 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.

4.05 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.

BASIS OF PAYMENT

1. New Pavement Construction

   Concrete Base Course constructed in new paving projects shall not be measured or paid for directly. Payment for Concrete Base Course shall be made as provided in Chapter 1 of these Specifications.

2. Pavement Replacement (Patching)

   When Pavement replacement or repair is required on the project, the method of measurement and payment shall be as provided in Chapter 1 of these Specifications.

B. VIBRATING

All concrete shall be thoroughly compacted by means of approved mechanical vibrators. 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.

4.05 CONCRETE PLACEMENT (Continued)

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 Engineer. The finish machine shall be operated over the entire width of the base and shall achieve uniform consolidation.

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 Engineer.

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.

4.06 JOINTS

A. CONSTRUCTION JOINTS

When placing of concrete is interrupted, for any reason, for over ½ hour, the concrete base shall be finished against an approved plank header, placed in a vertical position and extending completely across the roadway. Special care shall be taken to consolidate the concrete against the surface of the plank.

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 one-third (1/3) points of the slab width for pavements having a total width of 33 feet or less, and at the quarter points of the slab width for pavement having a total width greater than 33 feet but less than or equal to 44 feet. Transverse control joints shall be placed at intervals of 30 feet 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 one-third (1/3) of the concrete thickness by such methods that may be approved by the Engineer.

4.06 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 drawings.

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.

4.07 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

   Immediately 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. 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

   Immediately after the concrete has been finished, burlap shall be carefully placed on the concrete and kept moist in a manner which will not damage the pavement surface. 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.

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 Engineer's satisfaction. No heavy equipment or vehicular traffic shall be allowed on the new construction until the concrete has achieved a compressive strength of 2250 p.s.i. for LB-2750 or 3000 p.s.i. for L-3500 or seven (7) days have elapsed from date of placement. A longer period of time may be required if, in the opinion of the Engineer, 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.

4.08 TEMPORARY STOP PLANK

Temporary stop planks shall be placed at the ends of all streets and intersections when the extended street or side streets are unpaved. The temporary stop plank shall consist of a fir plank two inches by eight inches (2"x8") in size. It shall extend across the entire width of the roadway and shall be spiked securely to stout posts two feet in length, spaced not over five feet apart and driven well into the ground. The stop plank shall be backed with sufficient concrete to furnish proper support. The upper edge of the stop plank shall conform to the typical cross section for the concrete base.

No measurement or direct payment shall be made for the placement of the temporary stop plank. Placement of the stop plank shall be considered subsidiary to the items for which direct payment is made.

4.09 COLD WEATHER CONSTRUCTION

Portland Cement concrete paving work shall be accomplished only as provided in Section 1.06 of these Specifications.

4.10 SUBSTANTIAL COMPLETION

Paving construction will be considered substantially complete when it meets all of the requirements of Section 1.07 of these Specifications.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 5

ASPHALTIC CONCRETE CONSTRUCTION

ARTICLE	TITLE
5.00	General
5.01	Related Items Specified Elsewhere
5.02	Materials
5.03	Equipment A. Distributors B. Asphalt Spreader and Finisher C. Rollers D. Surface Planer E. Trucks
5.04	Preparation of Existing Surface A. Cleaning B. Surface Planing C. Correction of Pavement Failures D. Tacking E. Non-woven Pavement Overlay Fabric
5.05	Hauling & Spreading Asphaltic Concrete Mixtures A. Hauling B. Spreading
5.06	Compacting & Finishing Asphaltic Concrete Mixtures A. Rolling B. Jointing C. Density & Density Samples D. Asphaltic Concrete Curb E. Cold Weather Placement

ARTICLE	TITLE
5.07	Basis of Payment A. Non-woven Pavement Overlay Fabric B. New Pavement Construction C. Pavement Reconstruction D. Resurfacing

CHAPTER 5

ASPHALTIC CONCRETE CONSTRUCTION

5.00 GENERAL

Asphaltic concrete mixtures required for surface courses, base courses, overlays, wedge courses, and patching shall be placed as hereinafter specified.

Patching shall be defined as pavement replacement of areas requiring small quantities of asphaltic concrete per placement such as utility crossings and connections to existing streets, or larger quantity placements such as longitudinal cuts for utility work not requiring curb to curb asphalt replacement, and for other similar situations as directed by the Engineer.

5.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1 Pavement Construction and Reconstruction
Chapter 2 Earthwork
Chapter 4 Portland Cement Concrete Base
Chapter 12 Asphaltic Concrete

5.02 MATERIALS

Asphaltic Concrete shall be of the Superpave class as shown on the Plans or in the Contract Special Provisions and as defined in Chapter 12 of these Specifications. Asphaltic concrete for patching shall be any mixture approved by the Engineer.

5.03 EQUIPMENT

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 Engineer. The Contractor shall furnish the necessary accessories, equipment data, and assistance required by the Engineer for making tests and calibrations on equipment.

A. 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.

5.03 EQUIPMENT (Continued)

B. 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 it shall be operated to lay widths as approved by the Engineer.

C. ROLLERS

The number of rollers furnished shall be not less than two independent units, one being a steel wheeled roller and the other a pneumatic tire roller. In lieu of two rollers, one may be used if it is a vibratory roller with one set of pneumatic tires and with separate controls for energy and propulsion, which produces the specified density and a satisfactory surface.

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 tires and 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.

D. SURFACE PLANER

The planing machine shall be self-propelled, of sufficient weight, size, power and traction to remove surface irregularities without tearing or displacing of the remaining asphaltic surface or concrete pavement. The cutting edge or drum shall be designed and constructed to permit adjustment to match the existing roadway crown. The machine shall be so designed to permit operation against all curbs, catch basins, inlets and other appurtenances within the work area. The minimum grinding or planing width of the machines shall be 30 inches. Alternate equipment will not be acceptable without prior written approval of the Engineer.

E. 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 Engineer.

5.03 EQUIPMENT (Continued)

E. TRUCKS (Continued)

All trucks shall be equipped with a suitable waterproof canvas cover to protect the material as required by the Engineer. 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.

5.04 PREPARATION OF EXISTING SURFACE

A. 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 brooming 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.

B. SURFACE PLANING

Surface planing shall consist of grinding or planing of existing asphaltic or concrete pavements to remove any surface irregularities to within a predetermined specified limit, in accordance with the requirements of these Specifications, at locations shown in the plans, or as directed by the Engineer.

Unless the total street width is to be planed, prior to beginning the operation the Engineer shall indicate all individual areas to be planed. These areas shall be rectilinear, except where existing obstructions prohibit this shape.

Surface planing shall be accomplished without gouging or tearing of the remaining pavement surface. The Contractor shall make as many passes with the planing machine as necessary to remove the surface. Surface planing shall include the grinding of all dissimilar material.

Following the final pass, the planed surface shall be within a tolerance of 1/4 inch when checked with a 10 foot straightedge.

5.04 PREPARATION OF EXISTING SURFACE (Continued)

B. SURFACE PLANING (Continued)

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.

The Contractor shall remove all pavement cuttings which result from the performance of this work and deliver them to locations approved by the Engineer.

BASIS OF PAYMENT

When called for in the proposal, the cost of operating the surface planer and the cost of collecting and hauling the pavement cuttings shall be paid for at the contract unit price per hour for each piece of equipment during the time that it is in use. Cleaning required subsequent to the initial removal of the cuttings shall be as provided in Paragraph A above.

When called for in the proposal, SURFACE PLANING, completed in conformance with the plans and Specifications and accepted by the Engineer, 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, planing, removal of materials, labor, tools, equipment, clean up and incidentals necessary to complete the work.

C. CORRECTION OF PAVEMENT FAILURES

After the surface planing and cleaning have been accomplished, the Engineer shall examine the pavement structure to which the asphaltic concrete is to be applied. Any pavement failures shall be repaired as designated by the Engineer.

BASIS OF PAYMENT

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.

D. 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.

5.04 PREPARATION OF EXISTING SURFACE (Continued)

D. TACKING (Continued)

Traffic shall not be permitted on the tack coat without the permission of the Engineer, 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 Engineer. 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.

E. NON-WOVEN PAVEMENT OVERLAY FABRIC

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 inch and larger shall be filled with a suitable material as directed by the Engineer. 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 inches 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.

Immediately after the placement, the fabric shall be embedded into the asphalt cement sealant with a pneumatic roller, unless otherwise directed by the Engineer. 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.

5.05 HAULING AND SPREADING ASPHALTIC CONCRETE MIXTURES

A. HAULING

Clean trucks fully fueled shall be weighed in the morning when starting up and then again in the early afternoon to obtain accurate tare weights. The Engineer may also require re-weighing at any time to obtain new tare weights.

B. 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.

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 Engineer.

The cost of hauling and spreading the asphaltic concrete mixture shall be considered subsidiary to other items for which payment is made.

5.06 COMPACTING AND FINISHING ASPHALTIC CONCRETE MIXTURES

A. ROLLING

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 warm 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 density core locations have been marked by 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. The completed surface shall be smooth and true and shall conform to the grade, cross section and contour required without any irregularities that exceed 1/8 inch when tested with a 10 foot straightedge. Any defective areas shall be remedied at once as directed by the Engineer.

B. 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 placement shall be maintained as directed by the Engineer.

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.

No measurement or direct payment shall be made for the operations of rolling and jointing asphaltic concrete pavement. The cost thereof shall be considered subsidiary to other items for which direct payment is made.

C. DENSITY AND DENSITY SAMPLES

1. General

During the construction of asphaltic concrete pavement, the Contractor shall obtain core samples from each pavement lift for the determination of density. These samples shall be taken not later than seven (7) days after the date of placement of the asphaltic concrete at locations designated by the Engineer and shall be delivered to the City Testing Lab immediately after removal from the pavement. The samples shall be taken by drilling with a minimum 4 inch diameter core drill. After removal from the pavement, the cores shall not be sawed, trimmed, or modified by the Contractor in any way so that the actual lift thickness may be determined by the Engineer. The surfaces from which the samples have been taken shall be restored by the Contractor with hot asphaltic concrete mixture on the next succeeding date of plant operation but not later than seven (7) days after placement. Density samples shall be tested in accordance with the Nebraska Standard Method of Tests for specific gravity of compressed bituminous mixtures, NDR T 166. The void-less density for each lot sample shall be tested in accordance with the Nebraska Standard method of test for Maximum Specific Gravity of Bituminous Paving Mixtures, NDR T 209.

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 days production. The location of each of the required samples shall be determined by the Engineer. The % of Payment for each lot of asphaltic concrete shall be in accordance with Table “A” of this Section. The % of Payment in Table “A” shall be reduced by 5% for any lot represented by initial density samples received by the City Testing Lab more than (7) days from date of placement.

C. DENSITY AND DENSITY SAMPLES (Continued)

2. Arterial Streets

The asphaltic concrete for arterial streets shall be compacted to a density of not less than ninety-two and one half percent (92.5%) of the void-less density for that mixture. If any density test result indicates a compaction value of less than ninety-two and one half percent (92.5%) of the void-less density, two additional check cores will be obtained from that lot by the Contractor at points designated by the Engineer not later than 14 days after date of placement and delivered to the City Testing Lab immediately after removal from the pavement as described above. The % of Payment in Table "A" shall be reduced by 5% for any lot represented by check cores received more than (14) days from date of placement. The average density of the three samples shall be considered the density of the lot. In the event a sample is obviously damaged, an alternate sample will be obtained within 3 feet of the location of the damaged sample.

Reduction in payment for each lot of asphaltic concrete will be made according to the following table:

TABLE 'A'

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

When the asphaltic concrete is bid as a part of the total pavement structure, the reduction in payment will be based on fifty percent (50%) of the unit bid price for that pavement item on a square yard basis.

Where removal is required, no payment will be made for the asphalt concrete surfacing ordered removed or the cost associated with the removal thereof.

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 nominal layer thickness is either less than 1 inch or less than one and a half times the nominal maximum size of the aggregate contained in the asphaltic concrete mixture, the sampling and testing of density for this layer shall be waived. When the nominal thickness of a layer is greater than 1 inch and also equal to or greater than one and a half times the nominal maximum size of aggregate contained in the asphaltic concrete mixture, the thickness of the density sample or samples shall also equal or exceed these thickness requirements. Density determinations shall be waived for any lot when the maximum thickness requirements are not met by any of three samples taken at random.

C. DENSITY AND DENSITY SAMPLES (Continued)

3. Non Arterial Streets and Parking Areas

The general requirement for Density and Density Samples shall be the same as that for Arterial Streets.

When the asphaltic concrete is bid as a part of the total pavement structure, the reduction in payment will be based on fifty percent (50%) of the unit bid price for that pavement item on a square yard basis.

Where removal is required, no payment will be made for the asphalt concrete surfacing ordered removed or the cost associated with the removal thereof.

No measurement or direct payment shall be made for obtaining core samples for the determination of the density pay factor and layer thickness and restoring the surface. Obtaining core samples and restoring the surface shall be considered subsidiary to the items for which direct payment is provided.

D. ASPHALTIC CONCRETE CURB

When called for on the plans, asphaltic concrete curb shall be constructed of the same type of asphaltic concrete as the adjoining surface course, or as shown on the plans. The asphaltic concrete 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 Engineer.

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, surface course shall be heated so that it is sufficiently plastic to form a bond with the hot asphaltic concrete curb.

5.06 COMPACTING AND FINISHING ASPHALTIC CONCRETE MIXTURES (Continued)

E. COLD WEATHER PLACEMENT

When weather conditions are expected to adversely affect the temperature of the Asphaltic Concrete during placement and compaction, all haul trucks shall be covered and insulated as directed by the Engineer.

The temperature of the Asphaltic Concrete during placement shall be such that compaction is accomplished within the temperature range as specified by the Asphalt Binder supplier for the grade of binder being used.

Asphaltic Concrete shall not be placed when the ambient temperature during placement is expected to fall below 35°F, without permission from the Engineer.

Asphaltic concrete shall not be placed on frozen or frost covered subgrade or base. Table 'B' shall be used by the Engineer 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 Engineer if deviating from Table 'B'.

TABLE 'B'

Lift Thickness	Minimum Surface Temperature
Less than 2 inches	**45°F**
2 to 3 inches	**37°F**
Greater than 3 inches	**35°F**

5.07 BASIS OF PAYMENT

A. NON-WOVEN PAVEMENT OVERLAY FABRIC

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.

B. NEW PAVEMENT CONSTRUCTION

1. No direct payment shall be made for the asphaltic concrete surface course on new pavement construction. It shall be considered subsidiary to the price bid for ASPHALTIC CONCRETE PAVEMENT, CLASS 1 or ASPHALTIC CONCRETE PAVEMENT, CLASS 2, as provided in Section 1.03 of these Specifications.

5.07 BASIS OF PAYMENT (Continued)

2. No direct payment shall be made for the asphaltic concrete base course on new pavement construction. It shall be considered subsidiary to the price bid for ASPHALTIC CONCRETE PAVEMENT, CLASS 2, as provided in Section 1.03 of these specifications.

3. Asphaltic concrete curb shall be measured and paid for at the contract unit price bid per linear foot for the item ASPHALTIC CONCRETE CURB.

C. PAVEMENT RECONSTRUCTION

ASPHALTIC CONCRETE used as a surface course, wedge course, overlay, or for patching utility cuts, constructed in conformance to these Specifications and accepted by the Engineer, shall be paid for on a lot basis at the appropriate contract unit price bid per ton. Such payment shall be considered full compensation for all material, labor, equipment, tools, and incidentals necessary to complete the reconstruction in a condition acceptable to the Engineer.

D. RESURFACING

ASPHALTIC CONCRETE used as a surface course, wedge course, or overlay, constructed in conformance to these Specifications and accepted by the Engineer, shall be measured and paid for on a lot basis at the appropriate contract unit price bid per ton. Such payment shall be full compensation for all material, labor, equipment, tools, and incidentals necessary for the manufacture and placement, complete.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 6

PORTLAND CEMENT CONCRETE CURBS AND MEDIAN CONSTRUCTION

ARTICLE	TITLE
6.00	General
6.01	Related Items Specified Elsewhere
6.02	Materials
	A. Concrete
	B. Tie Bars
	C. Preformed Expansion Joint Material
	D. Joint Sealer
	E. Curing Compounds
6.03	Preparation of Subgrade
6.04	Forms
	A. Slip Forms
	B. Rigid Forms
6.05	Placing Tie Bars
6.06	Concrete Placement
	A. Vibrating
	B. Finishing
	C. Curb Drops
6.07	Joints
	A. Contraction Joints
	B. Expansion Joints
	C. Joint Sealing
6.08	Curing and Protection
6.09	Hot and Cold Weather Construction

ARTICLE	TITLE
6.10	Substantial Completion
6.11	Basis of Payment

CHAPTER 6

PORTLAND CEMENT CONCRETE CURBS AND MEDIAN CONSTRUCTION

6.00 GENERAL

Portland cement concrete curbs and medians shall be constructed of the materials as herein specified, on an approved subgrade, in accordance with these Specifications and in conformity with the lines, grades, typical cross sections and details shown on the plans.

6.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1 Pavement Construction & Reconstruction
Chapter 2 Earthwork
Chapter 3 Portland Cement Concrete Pavement
Chapter 4 Portland Cement Concrete Base

6.02 MATERIALS

A. CONCRETE

Unless otherwise specified all concrete shall be L3500 or LC3500 as described in Chapter 11 of these Specifications .

B. TIE BARS

All reinforcement bars shown on the plans shall conform to the requirements of "Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"ASTM A 615 (A 615M), Grade 40 (300) or grade 60 (420) and shall be free from rust, scale or other substances.

C. PREFORMED EXPANSION JOINT MATERIAL

When specified for use, 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 inch thick unless otherwise specified.

D. JOINT SEALER

The joint sealer shall conform to the requirements of "Concrete Joint Sealer, Hot-Poured Elastic Type", ASTM Designation D 1190, and shall meet or exceed the testing requirements of "Standard Test Methods for Sealants and Fillers, Hot Applied for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements" ASTM Designation D 5329 and the flow shall not exceed 20 mm.

E. CURING COMPOUNDS

All curing compounds shall be as described in Section 3.02.G. of these Specifications.

6.03 PREPARATION OF SUBGRADE

The subgrade for all types of curbs and medians shall be prepared in accordance with Chapter 2 of these Specifications.

No measurement or direct payment shall be made for preparation of subgrade. Preparation of subgrade shall be considered subsidiary to other items of work for which direct payment is made.

6.04 FORMS

A. SLIP-FORMS

All curbs shall be constructed using slip form paving equipment, except when specifically authorized by the Engineer.

Slip-form equipment shall be provided with traveling side and top forms of suitable dimensions, shapes, and strength to support the concrete for a sufficient length of time during placement to produce 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 which operate from an offset control line. The line and grade of the slip-form equipment shall be automatically controlled.

B. RIGID FORMS

Forms shall be set rigidly in place and have a uniform bearing on the approved subgrade, and shall be in conformity with established line and grade. The forms must be kept constantly straight and true with not more than 1/8 inch variation in horizontal or vertical alignment for each 10 feet in length. The forms shall be cleaned after each use and oiled with a light clear paraffin base oil which will not discolor or otherwise injure the concrete. Removal of the forms will not be permitted until the concrete has been in place for at least twelve (12) hours. Upon removal of the forms, all honeycombed areas or small defects shall be pointed up properly with a one part cement to two parts sand (1:2) mix grout. The concrete previously protected by the forms shall be cured as hereinafter specified or as directed by the Engineer.

No measurement or direct payment will be made for forms or slip-forming. The cost of forms or slip-forming shall be considered subsidiary to other items of work for which direct payment is made.

6.05 PLACING TIE BARS

Reinforcement bars shall be placed between the curb or curb and gutter and the pavement to act as tie bars on all paving projects and shall conform to the requirements of Section 6.02(b) herein. The tie bars shall be placed as shown on the drawings.

Tie bars will not be measured or paid for directly. The cost of the tie bars shall be considered subsidiary to the cost of those items for which direct payment is made.

6.06 CONCRETE PLACEMENT

The concrete shall be placed on an approved subgrade. 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.

A. VIBRATING

All concrete, whether placed by machine or by hand methods, shall be compacted thoroughly by means of mechanical vibrators approved by the Engineer. 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 vibration overlap.

No measurement or direct payment will be made for vibrating. Vibrating shall be considered subsidiary to other items of work for which direct payment is made.

B. FINISHING

If 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 Engineer. Unless otherwise provided in the Special Provisions, hand finishing as described herein may be employed only in cases of emergency and where mechanical methods are impractical.

1. Machine Finish

The finish machine shall be capable of placing, consolidating, striking off, shaping and float-finishing the freshly placed concrete to the desired line, grade, and thickness in one continuous passage in such a manner that a minimum of finishing by hand methods will be required.

The forward speed of the finishing machine or finishing machines, shall be adjusted to the average progress of the concrete production, in order that the slip form operations shall be as continuous and uninterrupted as possible.

Concrete shall be fed to the machine at a uniform rate. The machine shall be operated at a uniform rate to produce a well compacted mass of concrete free from surface pits.

The concrete shall be of such consistency that after placement it will maintain the shape of the required curb section without support.

The top and face of the finished curb shall be true and straight. The top surface of curbs shall be of uniform width, free from humps, sags, or other irregularities. When a straightedge 10 feet long is laid on the top or face of the curb or on the surface of gutters, the surface shall not vary more than 1/8 inch from the edge of the straightedge, except at grade changes or curves.

6.06 CONCRETE PLACEMENT (Continued)

B. FINISHING (Continued)

1. Machine Finish (Continued)

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. 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 add water to the surface to complete the finishing of the concrete, all mixing operations shall be discontinued immediately 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. The addition of superficial water to the surface of the concrete shall be at the Contractor's risk. The concrete shall be given a final finish by means of a wet burlap, carpet or broom drag over the full width, drawn over the surface in a longitudinal direction. The drag shall be suspended from a mandrel, or similar device, to insure evenness throughout the width of the drag. The drag shall be lifted from the surface of the concrete pavement when the finish machine is not in motion for thirty minutes or more, and carefully replaced before resuming the dragging operations. Drags shall be rinsed or washed at least every four (4) hours. Drags that cannot be cleaned shall be discarded and new drags substituted.

After the final drag finish, hand-formed or machine-formed joints shall be finished or refinished and the concrete over the joints carefully removed.

2. Hand Finish

The concrete shall be placed in such a manner that it can be consolidated, struck off, shaped and float finished so there will be no segregation of the concrete.

After the concrete has been deposited and spread, it shall be consolidated at maximum intervals of 2 feet longitudinally with approved vibrators, shaped with heavy templates or floats approved by the Engineer until the concrete is true to prescribed cross section, and struck off to a uniform height above the finished grade specified. The height of the strike-off above the grade shall be gauged as directed by the Engineer. In no case shall it be so scant that the surface of the concrete after tamping will be found below grade. The templates and floats used shall be of a design and construction suitable and adequate for the purpose required and for convenient use. They shall be of steel or steel-shod wood and shall have sufficient strength and stiffness to retain their shape under all working conditions. The working or screening edge shall be curved to the required cross section of the curb. The template or screed used for striking off shall be arranged so that when riding on the side form, the working edge will have an excess of concrete above grade to the height of strike-off determined and ordered by the Engineer.

6.06 CONCRETE PLACEMENT (Continued)

B. FINISHING (Continued)

2. Hand Finish (Continued)

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. 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 add water to the surface 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. The addition of superficial water to the surface of the concrete shall be at the Contractor's risk.

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

C. CURB DROPS

Curb drops shall be constructed at locations shown on the plans or as directed by the Engineer 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 thereof shall be considered subsidiary to the item or items CONCRETE CURB or COMBINED CURB AND GUTTER.

6.07 JOINTS

A. CONTRACTION JOINTS

Contraction joints shall be spaced as shown on the drawings or at a spacing approved by the Engineer. The joints shall be made while the concrete is workable. The joint shall be cut with a pointing trowel to a minimum depth of 3 inches on all sides. Joints shall be rounded with a tool having a maximum radius of 3/8 inch.

B. EXPANSION JOINTS

A 1 inch expansion joint shall be placed full depth in all curbs at locations indicated on the plans or as directed by the Engineer. The joint shall be constructed of preformed non-extruding joint material. The joint shall be shaped accurately to fit the section of the curb. These expansion joints shall line up across the street.

C. JOINT SEALING

Joint sealing shall be accomplished as provided in Section 3.07 paragraph D.

No measurement or direct payment will be made for joints or joint sealing. This work shall be considered subsidiary to other items of work for which direct payment is made.

6.08 CURING AND PROTECTION

Curing and protection of concrete pavement work shall be in accordance with Section 3.08 of these Specifications

6.09 HOT AND COLD WEATHER CONSTRUCTION

Portland cement concrete pavement work shall be accomplished only as provided in Section 1.06 of these Specifications.

6.10 SUBSTANTIAL COMPLETION

Paving construction will be considered substantially complete when it meets all of the requirements of Section 1.07 of these Specifications.

6.11 BASIS OF PAYMENT

CONCRETE HEADER, COMBINED CURB AND GUTTER, CONCRETE BARRIER CURB, or CONCRETE MEDIAN CURB, completed in conformance with the plans and Specifications and accepted by the Engineer, 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. Such payment shall be full compensation for all preparation of subgrade, forms or slip forming, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, backfilling, clean up and incidentals necessary to complete the work.

CONCRETE MEDIAN NOSE, IN PLACE, completed in conformance with the plans and Specifications and accepted by the Engineer, shall be paid for at the contract unit price bid per each. Such payment shall be full compensation for all preparation of subgrade, forms, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, backfilling, clean up and incidentals necessary to complete the work.

CONCRETE MEDIAN SURFACING, 4" THICK, completed in conformance with the plans and Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per square foot. Such payment shall be full compensation for all preparation of subgrade, forming, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, backfilling, clean up and incidentals necessary to complete the work.

TACK-ON MEDIAN, completed in conformance with the plans and Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per square foot. Such payment shall be full compensation for all preparation of pavement surface, installation of dowels where necessary, forming, materials, labor, tools, equipment, jointing, finishing, curing, sawing, sealing, clean up and incidentals necessary to complete the work.

CITY OF LINCOLN, NEBRASKA STANDARD SPECIFICATIONS

Chapter 7

SIDEWALKS, DRIVEWAYS, AND BIKEWAYS

ARTICLE	TITLE
7.00	General
7.01	Related Items Specified Elsewhere
7.02	Materials
	A. Concrete
	B. Crushed Rock
	C. Tie Bars
	D. Preformed Expansion Joint Material
	E. Joint Sealer
	F. Curing Compounds
7.03	Preparation of Subgrade
7.04	Forms
	A. Rigid Forms
	B. Slip Forms
7.05	Placing Tie Bars
7.06	Concrete Placement
	A. Vibrating
	B. Finishing
7.07	Access Ramps
7.08	Joints
	A. Construction Joints
	B. Expansion Joints
	C. Joint Sealing
7.09	Curing and Protection
7.10	Hot and Cold Weather Construction
7.11	Substantial Completion
7.12	Basis of Payment

CHAPTER 7

SIDEWALKS, DRIVEWAYS, AND BIKEWAYS

7.00 GENERAL

Concrete sidewalks, driveways, and bikeways shall be constructed of the material herein specified, on an approved subgrade, in accordance with these Specifications and in conformance with the lines, grades, typical cross section and details shown on the Plan.

7.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1 Pavement Construction and Reconstruction
Chapter 2 Earthwork
Chapter 10 Crushed Rock Surfacing
Chapter 11 Portland Cement Concrete

7.02 MATERIALS

A. CONCRETE

Unless otherwise specified all concrete shall be L3500 as described in Chapter 11 of these Specifications.

B. CRUSHED ROCK

Crushed Rock for bikeway surfacing shall conform to the requirements of Chapter 10 of these Specifications.

C. TIE BARS

All reinforcement bars shall meet all the requirements of "Standard Specifications Deformed & Plain Billet Steel Bars for Concrete Reinforcement", ASTM Designation A 615, Grade 40 (300) or Grade 60 (420). Bars shall be free from excess rust, scale, or other substances which prevent the bonding of the concrete to the reinforcement.

D. PREFORMED EXPANSION JOINT MATERIAL

When specified for use, 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 inch thick unless otherwise specified.

E. JOINT SEALER

Joint sealer shall conform to the requirements of "Concrete Joint Sealer, Hot Poured Elastic Type", ASTM Designation D 1190, shall meet or exceed the testing requirements of "Standard Specification s Test Method for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavement" ASTM Designation D 5329, and the flow as specified in ASTM D 5329 shall not exceed 3/4".

7.02 MATERIALS (Continued)

F. CURING COMPOUNDS

All curing compounds shall be as described in Section 3.02.G. of these Specifications.

7.03 PREPARATION OF SUBGRADE

Subgrades shall be prepared in accordance with Chapter 2 of these 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.

No measurement or 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.

7.04 FORMS

A. RIGID FORMS

Upon completion and approval of the subgrade, the Contractor shall erect substantial forms of not less than the depth of the concrete to be placed. The forms shall be built straight and true and in conformance with established line and grade.

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 two percent (2%). Where sidewalks and bikeways are constructed adjoining the curb, the forms shall be so set that the sidewalk adjacent to the curb shall be 3/8 inch above the curb.

The forms shall not be removed until new concrete is at least twelve (12) hours old. During the operation of form removal the edges of the concrete shall be cured as hereinafter provided or, if approved by the Engineer, the exposed edges may be covered with moist earth.

B. SLIP FORMS

At the option of the Contractor and with the approval of the Engineer, slip form equipment may be used for construction of concrete sidewalks or bikeways.

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 sidewalk of 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.

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

7.05 PLACING TIE BARS

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 tie bars shall be as shown on the drawings. The reinforcement bar will act as a tie bar and shall conform to the requirements of Section 7.02(b). The tie bars shall project equally into the driveway and pavement section.

Tie bars will not be measured or paid for directly. The cost of tie bars shall be considered subsidiary to the cost of those items for which direct payment is made.

7.06 CONCRETE PLACEMENT

The concrete shall be placed in the forms on an accepted subgrade and spread in an approved manner. The concrete then shall be consolidated thoroughly, using an approved vibrating screed or in a manner approved by the Engineer. The concrete shall be so placed that no segregation of the materials occur.

A. VIBRATING

All concrete shall be thoroughly compacted by means of approved mechanical vibrators. The vibrator shall consolidate the full depth and width of the concrete to a uniform mass without segregation.

No measurement or direct payment will be made for vibrating. The cost of vibrating shall be considered subsidiary to other items of work for which direct payment is made.

B. FINISHING

The consolidation and finishing of concrete sidewalk or driveway may be accomplished by either machine or hand methods. The following requirements shall apply and all equipment used shall meet the approval of the Engineer.

1. Machine Finish

The finish machine shall be capable of placing, consolidating, striking off, shaping and float-finishing the freshly placed concrete to the desired line, grade, and thickness in one continuous passage in such a manner that a minimum of finishing by hand methods will be required. The finish machine shall be kept in good repair at all times and shall operate so as to give the desired finish over the entire surface. The finish machine shall be of a size and type capable of giving the desired results and shall be approved by the Engineer. The final finish shall be obtained with the use of a broom. Brooming shall be transverse to the line of traffic.

7.06 CONCRETE PLACEMENT (Continued)

B. FINISHING (Continued)

2. Hand Finish

The concrete shall be placed in such a manner that it can be consolidated, struck off, shaped and float finished so there will be no segregation of the concrete.

After the concrete has been deposited and spread, it shall be struck off and consolidated using vibrating screeds approved by the Engineer until the concrete is true to prescribed cross section. The vibrating screeds shall be of a design and construction suitable and adequate for the purpose required and for convenient use. They shall be designed to ride on the side forms. Screeds shall be metal or metal-shod wood and shall have sufficient strength and stiffness to retain their shape under all working conditions. The template or screed used for striking off shall be arranged so that when riding on the side form, the working edge will have an excess of concrete above grade. When finishing small and irregular areas, the concrete shall be consolidated with approved mechanical vibrators before the concrete is struck off.

Care shall be taken so the flow line of the gutter is not obstructed by the construction of driveways where they meet the curb and gutter section.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. 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 discontinued immediately 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. The addition of superficial water to the surface of the concrete shall be at the Contractor's risk.

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.

7.07 ACCESS RAMPS

Access ramps shall be constructed at the locations shown on the plans or as directed by the Engineer. All ramps shall be a minimum of 6 inches thick. All curb ramps shall be constructed with a Detectable truncated surface material in accordance with the Lincoln Standard Plans.

7.07 ACCESS RAMPS (Continued)

No separate measurement or direct payment shall be made for the construction of access ramps. Access ramps shall be measured and paid for at the appropriate unit price bid for CONCRETE SIDEWALK, 4" THICK or CONCRETE BIKEWAY, _____" THICK, and any extra cost thereof shall be considered subsidiary to this item. Detectable Truncated Surface material shall be paid for by the square foot of material in place.

7.08 JOINTS

A. CONTRACTION JOINTS

Before finishing the wearing surface, the concrete shall be jointed by cutting with a power driven saw to a minimum depth of one-fourth the slab thickness. Sidewalks and Bikeways shall be jointed at intervals approximating the design width and as square as possible. Driveways shall be jointed as indicated on the plans or as directed by the Engineer.

B. EXPANSION JOINTS

A 1 inch expansion joint shall be placed the full thickness of the sidewalks, driveways, or bikeways at the locations shown on the drawings. The joints shall be constructed of preformed non-extruding, bituminous impregnated joint material. All edges of expansion joints in new concrete shall be finished with a tool having a minimum radius of 3/8 inch . Where replacement sidewalks or driveways are being constructed, expansion material shall be placed at the appropriate locations, irrespective of whether such material was present in the sidewalks, driveways, or bikeways which were removed.

C. JOINT SEALING

Expansion joints and joints in commercial drives shall be sealed as provided in Section 3.07, Paragraph D. Construction joints in sidewalks and residential driveways shall not be sealed.

No measurement or direct payment will be made for joints or joint sealing. This work shall be considered subsidiary to other items of work for which direct payment is made.

7.09 CURING AND PROTECTION

All curing and protection of concrete work shall be in accordance with Section 3.08 of these Specifications.

7.10 HOT AND COLD WEATHER CONSTRUCTION

Portland cement concrete paving work shall be accomplished only as provided in Article 1.06 of these Specifications.

7.11 SUBSTANTIAL COMPLETION

Paving construction will be considered substantially complete when it meets all of the requirements of Article 1.07 of these Specifications.

7.12 BASIS OF PAYMENT

CONCRETE SIDEWALK, 4" THICK, CONCRETE DRIVEWAY, _____" THICK, and CONCRETE BIKEWAY, _____ " THICK that has been completed in conformance with the Plans and Specifications and accepted by the Engineer 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. Such payment shall be full compensation for all preparation of subgrade, forming, jointing, finishing, curing, sawing, sealing, backfilling, cleanup, materials, equipment, tools, labor and incidentals necessary to complete the work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 8

RETAINING WALLS AND STEPS

ARTICLE	TITLE
8.00	General
8.01	Related Items Specified Elsewhere
8.02	Materials
	A. Reference Standards B. Concrete C. Reinforcement D. Preformed Joint Filler Material E. Waterproofing F. Curing Compounds G. Handrail
8.03	Reinforced Concrete Walls and Steps Installation
	A. Excavation and Backfill B. Forms C. Reinforcement Placement D. Concrete Placement E. Joints F. Waterproofing G. Weephole H. Curing and Protection I. Hot and Cold Weather Construction J. Fence Placement K. Handrail Placement L. Substantial Completion

CHAPTER 8

RETAINING WALLS AND STEPS

8.00 GENERAL

The work covered in this Chapter shall include the construction of reinforced concrete retaining walls, and reinforced concrete steps.

Modular Block and Reinforced Earth Retaining Wall Systems shall be approved by the Engineer and shall meet the material specifications and be constructed according to the installation instructions provided by the manufacturer. In addition to the manufacturers specifications and installation instructions, these systems shall also include a wall location site plan certified by a licenced engineer, showing drainage volumes and overflow locations plus identifying soil types and adjacent loading conditions.

8.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1 Pavement Construction & Reconstruction
Chapter 2 Earthwork
Chapter 11 Portland Cement Concrete

8.02 MATERIALS

A. REFERENCE STANDARDS

1. ASTM C 90-75- Standard Specification for Loadbearing Concrete Masonry Units.
2. ASTM C 140-75 - Standard Specification for Sampling and Testing Concrete Masonry Unit and Related Units
3. ASTM D 638 - Standard Test Method for Tensile Properties of Plastic.
5. ASTM D 1248 - Standard Specifications for Polyethylene Plastics Molding and Extrusion Materials, for Wire and Cable.

B. CONCRETE

Unless otherwise specified, all concrete for reinforced, poured-in-place walls and steps shall be L3500 as described in Chapter 11 of these Specifications.

C. REINFORCEMENT

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).

8.02 MATERIALS (Continued)

C. REINFORCEMENT (Continued)

2. Welded Steel Fabric

Welded steel fabric shall consist of sheets or strips manufactured for this purpose. The steel wire shall comply with the "Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement", ASTM Designation A 185. Intersecting members shall be rigidly welded at right angles in such a manner as to develop the full tensile strength across the weld. Steel fabric is specified on the plans by gauge and spacing of wires. The gauge number specified shall be in accordance with ASTM Wire Gauge Standards as given in the above reference.

3. 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.

D. 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.

E. 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 Engineer. The provisions in the above-referenced 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.

8.02 MATERIALS (Continued)

F. CURING COMPOUNDS

All curing compounds shall conform the requirements of Section 3.02.G. of these Specifications.

G. 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 Engineer.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION

A. EXCAVATION AND BACKFILL

All earthwork shall conform to the requirements of Chapter 2 of these 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.

B. 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.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION (Continued)

B. FORMS (Continued)

1. BRICK FACED FORMS

Forms used for brick facing shall be cast aluminum or approved equal, unless otherwise specified by the Engineer. 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.

C. REINFORCEMENT PLACEMENT

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 six (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.

All reinforcing steel shall be furnished in full length, except where splices are indicated in the plan or permitted by the Engineer. 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 thirty-six (36) bar diameters for Grade 40 (300) and twenty-four (24) bar diameters for Grade 60 (420) steel. Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment and clearances.

BASIS OF PAYMENT

Payment for REINFORCING STEEL FOR STEPS AND RETAINING WALLS, IN PLACE, constructed in conformance with the plans and Specifications, and accepted by the Engineer, 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.

8.03 REINFORCED CONCRETE RETAINING WALLS AND STEPS INSTALLATION (Continued)

D. 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 feet. 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 inches 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 insure 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 Engineer.

D. CONCRETE PLACEMENT(Continued)

2. SURFACE FINISH (Continued)

After removal of brick-faced forms, all irregularities in the finish shall be corrected to the satisfaction of the Engineer. 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.

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.

BASIS OF PAYMENT

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.

E. 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 Specifications and approved by the Engineer. When not detailed in the plans, or in case of emergency, construction joints shall be placed as directed by the Engineer.

The surface of the hardened concrete shall be roughened as required by the Engineer, 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.

E. JOINTS (Continued)

2. SURFACE FINISH (Continued)

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.

2. 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.

3. 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.

F. WATERPROOFING

The back face of all retaining walls over 2 feet 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° F. 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.

F. WATERPROOFING (Continued)

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.

G. WEEPHOLE

Weep-holes shall be constructed in all retaining walls as shown on the plans or as directed by the Engineer.

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.

H. 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 seven (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 seven (72) hours after the concrete has been placed.

H. CURING AND PROTECTION (Continued)

1. CURING (Continued)

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 Section 3.02.G of these 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.

I. 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 Engineer. During hot or cold weather the work may proceed in accordance with Section 1.06 of these Specifications.

J. FENCE PLACEMENT

Fences shall placed along the tops of retaining walls where shown on the plans. These fences shall be constructed in accordance with the provisions of Chapter 9 of these Specifications.

K. HANDRAIL PLACEMENT

Handrails shall be placed at the locations and in accordance with the details shown on the plans, and as specified in these Specifications and the Special Provisions, and as directed by the Engineer.

The type of railing to be constructed shall be specified in the special provisions or shown on the plans.

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.

K. HANDRAIL PLACEMENT (Continued)

All handrails, posts, and paint shall be of the size and materials as shown on the plans, Specifications, or as directed by the Engineer.

Primer paint shall be applied to a dry thickness of 2.0 to 3.5 mils and two (2) coats of enamel shall be applied to a dry thickness of 1.5 to 2.5 mils for each coat.

BASIS OF PAYMENT

HANDRAILS, COMPLETE, constructed in conformance with the plans and Specifications and accepted by the Engineer, 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.

L. SUBSTANTIAL COMPLETION

Retaining walls and steps will be considered substantially complete when all steel and concrete is placed, cured, and finished, waterproofed, backfill completed, and handrail completed.

CITY OF LINCOLN, NEBRASKA STANDARD SPECIFICATIONS

Chapter 9

CHAIN LINK FENCING AND PIPE RAIL FENCING

ARTICLE	TITLE
9.00	General
9.01	Related Items Specified Elsewhere
9.02	Materials
	A. Chain Link Fence B. Pipe Rail Fence C. Rigid Cellular Plastic Backfill D. Polyurethane Sealant
9.03	Fence Installation
	A. Chain Link Fence B. Pipe Railing Fence

CHAPTER 9

CHAIN LINK FENCING AND PIPE RAIL FENCING

9.00 GENERAL

The work of in this Chapter shall include the installation of chain link fencing and pipe rail fencing.

9.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 8	Retaining Wall and Steps
Chapter 21	Storm Sewers

9.02 MATERIALS

A. CHAIN LINK FENCE

Materials for chain link fencing shall be standard commercial products which meet the general requirements of these Specifications.

Chain link fence fabric shall be No. 9 gauge wire woven in a 2 inch 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 inches and weight of 3.52 pounds per foot.

Top rail shall be round having a nominal outside diameter of 1 ½ inches) and weight of 1.77 pounds per foot.

Post braces shall be round tubular steel having a nominal outside diameter of 1 ½ inches and weight of 1.77 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 inches 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 ½ inches and a minimum length of 12 inches.

9.02 MATERIALS (Continued)

B. PIPE RAIL FENCE

Materials for pipe railing fencing shall be standard commercial products which meet the general requirements of the specifications.

All pipe used for railing shall be round tubular steel (Schedule 40) galvanized pipe having nominal outside diameter of 1 3/8 inches.

All end, corner and intermediate posts shall be round tubular steel (Schedule 40) galvanized pipe having a nominal outside diameter of 1 3/8 inches.

The tee, cross elbow and flange connectors shall be malleable iron connectors as approved by the Engineer. 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.

Pipe sleeves shall be round, galvanized steel, have a nominal inside diameter of 1 ½ inches and a minimum length of 12 inches.

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.

9.03 FENCE INSTALLATION

A. CHAIN LINK FENCE

New chain link fencing 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 feet and shall be set in 3 feet of concrete base 12 inches in diameter. Exposed surface of concrete shall be crowned to shed water.

Post spacing for posts to be set on concrete wall shall not exceed 10 feet 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 inches into the sleeve.

9.03 FENCE INSTALLATION (Continued)

A. CHAIN LINK FENCE (Continued)

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 inch below the top of the sleeve. Care shall be taken to insure 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 inch reservoir. The resulting reservoir shall be filled with one-part, self-leveling polyurethane sealant installed in accordance 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 inch galvanized steel truss rod with a turnbuckle for adjustment.

Fastening to all terminal posts shall be with stretcher bars and fabric bands at 16 inch intervals. Fastening to line posts shall be tie wire or other approved method at 16 inch intervals.

Fastening to top rail shall be with wire ties at intervals not exceeding 20 inches. Fastening to bottom tension wire shall be with wire ties at intervals not exceeding 2 feet.

BASIS OF PAYMENT

Chain link fences installed in accordance with the plans and these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per foot for _____ ____" CHAIN LINK FENCE, IN PLACE, for the various sizes called for in the proposal.

B. PIPE RAILING FENCE

New pipe rail fencing 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 Engineer.

Post spacing shall not exceed 10 feet 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 inches 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 inch below the top of the sleeve. Care shall be taken to insure 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 inch reservoir. The resulting reservoir shall be filled with one-part, self-leveling polyurethane sealant installed in accordance with the manufacture'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.

BASIS OF PAYMENT

Pipe rail fence, installed in accordance with the plans and these specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per linear foot for ___ _____" PIPE RAIL FENCE, IN PLACE. Such payment shall be full compensation for all castings, pipe, sleeves, plastic backfill, 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 10

CRUSHED ROCK SURFACING

ARTICLE	TITLE
10.00	General
10.01	Related Items Specified Elsewhere
10.02	Materials
	A. Crushed Rock B. Gravel
10.03	Equipment
10.04	Placement and Compaction
	A. Roadway Surfacing B. Bikeway Surfacing
10.05	Basis of Payment

CHAPTER 10

CRUSHED ROCK SURFACING

10.00 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 Roads "Gravel and Rock Producers" list unless otherwise approved by the Engineer.

10.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1 Construction and Reconstruction of Pavement
Chapter 2 Earthwork
Chapter 7 Sidewalks, Driveways and Bikeways

10.02 MATERIALS

A. CRUSHED ROCK

1. General

Crushed rock shall be either limestone or dolomite and shall consist of clean, hard, tough and durable fragments (excluding schist, shale or slate) of uniform quality throughout and shall be free from thin, soft, or elongated pieces, disintegrated stone, dirt, organic or other deleterious material occurring free or as a coating on the rock.

2. Gradation

The crushed rock for surfacing shall be screened after crushing to remove excessive fines and shall be so graded as to meet the following requirements:

Sieve Size	Percent Passing
1-1/2"	94-100
½"	0-10

Crushed rock for bikeway surfacing shall meet the following gradation requirements:

Sieve Size	Percent Passing
3/8"	100
#4	85-100
#8	53-83
#16	33-53
#30	20-40
#50	16-28
#100	13-23
#200	12-20

10.02 MATERIALS (Continued)

A. CRUSHED ROCK (Continued)

3. Soundness

The fraction of crushed rock retained on the ½-inch sieve shall have a loss ratio of not less than 0.75 when subjected to 26 cycles of freezing and thawing in accordance to AASHTO Method T-103.

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 percent.

B. GRAVEL

1. General

Gravel for surfacing shall consist of durable particles of stone and sand with less than five percent (5%) of clay and silt.

2. Gradation

The sieve analysis for the gravel material shall be made in accordance with AASHTO Method T-27 and shall be so graded so as to meet the following requirements:

Sieve Size	Percent Passing
1"	100
#4	61-95
#10	0-30
#200	0-4

The percent passing the No. 200 sieve shall be determined in accordance with AASHTO Method T-11.

3. Soundness

The fraction of gravel contained on the No. 16 sieve shall have a soundness not to exceed ten percent (10%) at the end of five (5) cycles, except that the material having a soundness loss greater than ten percent (10%) may be accepted at the discretion of the Engineer, subject to an adjustment of the quantity for which payment will be made. Soundness shall be determined in accordance 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 accordance with AASHTO Method T-2.

10.03 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.

10.04 PLACEMENT & COMPACTION

A. ROADWAY SURFACING

In general, this construction shall include combining three inches of crushed rock in the upper layer of the subgrade and the application of a one-inch gravel surface to the crushed rock base, to the widths and cross section as provided by the plans or directed by the Engineer.

The crushed rock material shall be deposited uniformly upon an approved sub- grade in straight, single or double lines, followed immediately thereafter by scarification of the rock and subgrade to produce a uniform soil-rock mixture six inches 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 Engineer.

B. BIKEWAY SURFACING

In general, bikeways constructed of crushed rock shall consist of a layer of crushed rock placed on a prepared subgrade to the width and cross section as provided by the plans, indicated in the special provisions, or as directed by the Engineer.

10.05 BASIS OF PAYMENT

CRUSHED ROCK ROADWAY SURFACING, IN PLACE, and GRAVEL SURFACING, IN PLACE, that has been completed in conformance with the Plans and Specifications and accepted by the Engineer 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 Engineer. 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.

CRUSHED ROCK BIKEWAY SURFACING, IN PLACE that has been completed in conformance with the Plans and Specifications and accepted by the Engineer 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 Engineer. 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 11

PORTLAND CEMENT CONCRETE

ARTICLE	TITLE
11.00	General
11.01	Materials
	A. Cement B. Aggregate C. Water D. Chemical Admixtures E. Fly Ash and Natural Pozzolan Modified Portland Cement Concrete
11.02	Proportions of Mixtures
11.03	Handling Materials
11.04	Weighing & Mixing
11.05	Consistency and Placement of Concrete
11.06	Concrete Tests
11.07	Flowable Fill

TABLES	TITLE
11.01	Gradation Limits for Mineral Aggregates for Use in Portland Cement
11.02	Portland Cement Concrete Mixtures
11.03	Flowable Fill Composition

CHAPTER 11

PORTLAND CEMENT CONCRETE

11.00 GENERAL

Portland Cement Concrete shall consist of an intimate mixture of Portland Cement, aggregate, water and an air-entraining admixture. Depending on the application, other constituents or admixtures may be used with permission from the Engineer. Materials not on the latest edition of the Nebraska Department of Roads "Approved Products List" shall not be used without permission from the Engineer. The constituents of Portland Cement Concrete and their mixing, handling, and proportioning shall conform to ASTM Designation C 94 except as modified herein.

11.01 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 percent equivalent alkali. Equivalent alkali is defined as the sum of the sodium oxide (Na_2O) and the potassium oxide (K_2O) calculated as sodium oxide (equivalent alkali as $Na_2O = Na_2O + 0.658(K_2O)$). Certified mill tests shall be furnished to the Engineer. 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 Engineer. Contractors or subcontractors supplying concrete shall notify the Engineer when changing to a different cement.

The cement shall be protected from damage due to moisture. Cement so damaged will be rejected. Cement shall not be in storage longer than ninety (90) days without retesting. The temperature of the cement when used shall be less than 180°F.

B. AGGREGATE

1. General

Only aggregates that have been approved by the Nebraska Department of Roads and used for similar work and have satisfactory service records will be approved.

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.

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 percent computed as CaCO3 from the value determined for CaO.

B. AGGREGATE (Continued)

1. General (Continued)

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 Engineer.

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

ASTM DESIGNATIONS

C 33	Specification for Concrete Aggregates

AASHTO DESIGNATIONS

T 96	Abrasion
T 104	Sodium Sulfate Soundness
T 21	Organic Impurities
T 71	Mortar-Making Properties

NEBRASKA DEPARTMENT OF ROADS

NDR T 2	Sampling
NDR T 27	Sieve Analysis
NDR T 504	Clay Lumps, Shale, and Soft Particles
NDR T 103	Freeze and Thaw Soundness
NDR T 85	Specific Gravity and Absorption (Coarse Aggregate)
NDR T 84	Specific Gravity and Absorption (Fine Aggregate)
NDR T 89	Determining The Liquid Limit of Soils
NDR T 90	Determining The Plastic Limit and Plasticity Index of Soils
NDR T 5	Calcium Carbonate
NDR T 248	Reducing Field Samples of Aggregate to Testing Size

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

B. 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 Engineer'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 Engineer 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 Specifications shall be rejected and removed from the site of the work.

Aggregates shall meet the gradation requirements of Table 11.01, for the Class of Concrete shown in Table 11.02, of these specifications. For all other applications such as overlay concrete or mortar and grout sands, the gradation requirements in Section 1033, "Aggregates", of the latest version of the Nebraska Department of Roads "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 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 percent by weight at the end of 5 cycles using sodium sulfate solution.

The aggregate shall contain no more than one-half percent (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 accordance 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 percent solution of sodium hydroxide. Materials failing to produce equal or greater strength shall not be accepted, without permission from the Engineer.

11.01 MATERIALS (Continued)

B. AGGREGATE (Continued)

3. Coarse Aggregate

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

The calcium carbonate content of the aggregate shall be at least eighty percent (80%) (computed as $CaCO_3$ from value determined for CaO).

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

Clay Lumps	0.5 percent
Shale	1.0 percent
Soft Particles	3.5 percent

Any combination of clay lumps, shale and soft particles shall not exceed three and one-half percent (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 eight percent (8%) by weight at the completion of sixteen (16) cycles of alternate freezing and thawing.

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

11.01 MATERIALS (Continued)

B. AGGREGATE (Continued)

TABLE 11.01

GRADATION LIMITS FOR MINERAL AGGREGATES FOR USE IN PORTLAND CEMENT CONCRETE				
TYPE OF MATERIAL	FINE AGGREGATE		COARSE AGGREGATE	
USED IN CONCRETE CLASS:	SG3000, L3500, L4500, L5500, LB2750, LC3500, PR		L3500, L4500, L5500 LB2750, LC3500, PR	
TOTAL PERCENT PASSING SIEVE	Target	Tolerance	Target	Tolerance
1 ½"	--	--	100	None
1"	100	None	100	-8
3/4"			78	±12
½"			--	--
3/8"			30	±15
# 4	87	±10	6	±6
# 10	60	±10	--	--
# 20	--	--	3	±3
# 30	28	±12		
# 50				
# 100				
# 200	1.5	±1.5		

C. 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 ninety-five percent (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 Engineer.

D. CHEMICAL ADMIXTURES

All Chemical Admixtures shall conform to Section 1007, "Chemical Admixtures", of the latest addition of the Nebraska Department of Roads "Standard Specifications for Highway Construction".

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 ninety-two percent (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 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 Engineer.

E. FLY ASH AND NATURAL POZZOLAN MODIFIED PORTLAND CEMENT CONCRETE

Portland Cement Concrete mixes for pavement, driveways, curb, median, and sidewalk may be modified by replacing a maximum of ten percent (10%) of the cement per cubic yard of concrete, as shown in Table 11.02, with an amount of Class F fly ash equal to two (2) times the weight of cement removed or by the use of Type IPN, cement made with 15 to 25 percent natural pozzolan, or by the use of Type IPF, cement made with 15 to 25 percent Class F fly ash, in the amount shown in Table 11.02. No additional fly ash substitution will be allowed to mixes utilizing Type IPN or Type IPF cement.

11.01 MATERIALS (Continued)

E. FLY ASH AND NATURAL POZZOLAN MODIFIED PORTLAND CEMENT CONCRETE (Continued)

An NDOR approved water-reducing admixture shall be used in all fly ash and natural pozzolan modified concrete mixes at the dosage rate recommended by the manufacturer. The water-cement ratio of all fly ash and natural pozzolan modified concrete shall not exceed the maximum limit for the various classes of concrete as shown in Table 11.02.

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 six percent (6.0%). Additionally, Class F pozzolans shall have a maximum allowable free carbon content not to exceed three percent (3.0%). Class F fly ash shall not contain more than one and five-tenths percent (1.50%) of available alkalies as Na_2O. 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 Engineer.

Only brands of Class F Fly Ash, Type IPN Cement, and Type IPF Cement which are on the latest edition of the Nebraska Department of Roads Approved Products List shall be approved for use in concrete in City of Lincoln projects.

The fly ash shall be protected from damage due to moisture. Fly ash so damaged shall be rejected. Fly ash shall not be in storage longer than ninety (90) days without retesting.

Cement and fly ash may be weighed in the same weigh hopper. However, the cement shall be weighed completely before the fly ash enters the weigh hopper.

Fly ash, Type IPN cement, and Type IPF cement shall not be used in mix designations LB2750, L4500, L5500 and PR without permission from the Engineer.

Fly Ash and Natural Pozzolan Modified concrete will not be allowed in structures without permission from the Engineer.

Fly ash and Natural Pozzolan Modified concrete shall not be used after October 1st or before April 1st without permission of the Engineer.

11.02 PROPORTIONS OF MIXTURES

All Portland Cement Concrete mixtures shall be composed of a mixture of Portland Cement, water, mineral aggregates, and air-entrainment as specified; according to Table 11.02.

The proportions within the limits given shall be determined by the Engineer and shall not be varied by the Contractor.

TABLE 11.02 - PORTLAND CEMENT CONCRETE MIXTURES

CLASS OF CONCRETE	LB-2750		SG-3000		L-3500		LC-3500		L-4500		L-5500		PR	
NOTES (See Below)	(3), (5)		(1), (5)		(3), (5)				(3), (5)		(3), (5)		(2), (3), (4), (5)	
General Use	Pavement Base		Misc. (Where Specified)		Pavement, Sidewalk & Structures		Curb		Bridge Deck & High Strength		Pavement High Strength		Pavement Repair (H.E.)	
Min. 28 Day Strength, psi (MPa)	2750 (19)		3000 (20)		3500 (25)		3500 (25)		4500 (31)		4500 (31)		4500 (31)	
Lbs. of Cement / cubic yard (kg/m^3)	423 (251)		564 (335)		564 (335)		564 (335)		658 (390)		752 (446)		799 (474)	
Aggregate Composition % by Weight	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Fine Aggregate	58%	62%	100%	-----	67%	73%	67%	73%	67%	73%	67%	73%	67%	73%
Coarse Aggregate	38%	42%	-----	-----	27%	33%	27%	33%	27%	33%	27%	33%	27%	33%
Air Content	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
% of Volume	4.5	6.5	5.0	7.5	5.0	7.5	5.0	7.5	5.0	7.5	4.0	7.0	4.0	7.0
Maximum Water Cement Ratio	0.64		0.53		0.53		0.50		0.44		0.40		0.45	
Maximum Slump, inches (mm)	4.0 (102)		4.0 (102)		4.0 (102)		3.0 (76)		4.0 (102)		3.0 (76)		3.0 (76)	

NOTES:
(1) L3500 shall be used on all sidewalk constructed on City Contracts unless otherwise specified.
(2) Type III Cement
(3) No fly ash or natural pozzolan modified concrete allowed in pavement base, bridge, structures, high strength, or pavement repair mixtures without permission from the Engineer.
(4) Calcium Chloride may be added as per NDOR Standard Specifications for Highway Construction.
(5) The maximum slump may be exceeded by use of water reducer, high range water reducer, or both.
This table is for proportion ranges only. Actual mix design weights for specific applications will be provided by the City of Lincoln Materials Testing Laboratory.

11.03 HANDLING MATERIALS

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

The moisture content of the aggregate shall be reasonably uniform from batch to batch. Limestone having a moisture absorption of more than one percent (1%) shall be uniformly saturated with water before it is used. The saturation shall be performed sufficiently in advance of mixing operations to permit filling of the pores of the aggregate.

11.04 WEIGHING & MIXING

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 Engineer.

The concrete batch shall be either plant-mixed by the central batch plant or truck-mixed using transit mixing trucks. Mixing time and rate requirements shall be based on the size of batch and the mixing drum manufacturers specifications. Mixing time shall start when the cement and water are combined. 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 Engineer.

No concrete shall be used from a batch that has exceeded ninety (90) minutes from the start of mixing time. A lesser time may be specified by the Engineer if, in his opinion, conditions warrant it. Concrete hauled in non-agitating trucks shall be placed within thirty (30) minutes after mixing time starts.

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.

11.05 CONSISTENCY AND PLACEMENT OF CONCRETE

In general, the minimum amount of water shall be used which will produce the required work-ability. 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 11.02, shall not be exceeded.

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 Engineer. Concrete free fall distance shall not exceed 5 feet. 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.

11.06 CONCRETE TESTS

The Engineer shall take such tests of the concrete as he 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.

11.07 FLOWABLE FILL

A. DESCRIPTION

Flowable Fill 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 11.03.

Table 11.03 Flowable Fill Composition per cubic yard	
Cement (Type I or II)	60 pounds
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 percent passing the No. 4 sieve and not more than 5 percent passing the No. 200 sieve.

Handling and mixing of the materials shall be in accordance with sections 11.03 and 11.04 above.

Cement must be on the latest NDOR Approved Products List.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 12

ASPHALTIC CONCRETE

ARTICLE	TITLE
12.00	General
12.01	Related Items Specified Elsewhere
12.02	Materials
	A. Asphalt Binder
	B. Tack Coats
	C. Mineral Aggregates
	D. Non-woven Pavement Overlay Fabric
12.03	Asphaltic Concrete Mixtures
	A. General
	B. Volumetric Mix Design
	C. Materials Sampling and Testing
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12.04	Equipment
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TABLES	TITLE
12.00	Asphaltic Concrete Mix Requirements Summary
12.01	Gyratory Compaction Effort
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12.05	Aggregate Adjustment Tolerance
12.06	Coarse Aggregate Angularity
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12.09	Clay Content
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12.11	Gradation Control Points for 0.500 Nominal Size
12.12	Gradation Control Points for 0.750 Nominal Size

CHAPTER 12

ASPHALTIC CONCRETE

12.00 GENERAL

Asphaltic Concrete mixtures shall be classified as “Arterial Street”, “Non Arterial Street”, or “Parking Area” and shall consist of an intimate mixture of naturally occurring mineral aggregates of required gradations and asphalt binder content as hereinafter specified. Unless otherwise specified, no recycled or reclaimed pavement materials nor industrial or manufacturing byproducts will be allowed in the mixture. Asphaltic concrete shall be measured and paid for as provided in Chapter 5 of these Specifications.

12.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 1	Pavement Construction & Reconstruction
Chapter 2	Earthwork
Chapter 4	Portland Cement Concrete Base
Chapter 5	Asphaltic Concrete Construction

12.02 MATERIALS

A. ASPHALT BINDER

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

The asphalt binder for all mixes shall conform to the requirements of AASHTO M 320 for Performance Graded Asphalt Binder. The PG Binder shall meet or exceed both the upper and lower temperature targets of PG 70-28 for Arterial Street and Non Arterial Street mixes and PG 64-22 for Parking Area mixes and mixes used in temporary pavement or pavement patching unless directed otherwise by the Engineer.

In addition, unless for use in temporary pavement or otherwise directed by the Engineer, the PG Binder for Arterial Street and Non Arterial Street mixes shall be Polymer Modified. Polymer Modified Asphalt Binder shall be polymerized with a minimum of 3%, by weight, of virgin SB/SBS (styrene-butadiene or styrene-butadiene-styrene block copolymers) or SBR (styrene-butadiene rubber latex or polychloroprene latex). 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 suppliers storage and handling recommendations.

A Material Certification from the PG Binder Supplier shall be submitted prior to construction, stating the type of polymer modifier being used and the recommended mixing and compaction temperatures for the Hot Mix Asphalt. 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.

When moisture susceptibility testing indicates the need for an anti-stripping additive, it shall be added by the PG Binder Supplier. The Contractor shall be compensated for the cost of the anti-stripping additive at the invoice price of the additive. The bill of lading or delivery ticket shall state the binder grade, specific gravity, and the percentage of anti-strip additive.

12.02 MATERIALS (Continued)

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 Designation D 977	Standard Spec. for Emulsified Asphalts
ASTM Designation D 2397	Standard Spec. for Cationic Emulsified Asphalts
ASTM Designation D 140	Standard Practice for Sampling Bituminous Materials
ASTM Designation D 244	Standard Testing Emulsified Asphalts:

Emulsified asphalts covered by these Specifications shall be diluted in the distributor with sufficient potable water to reduce the asphalt residue in the mixture to approximately thirty percent (30%). Emulsified asphalt shall be homogeneous within the thirty (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.

C. MINERAL AGGREGATES

1. General

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

ASTM Designation D 692	Standard Specification for Coarse Aggregate for Bituminous Paving Mixture
ASTM Designation D 1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixture
ASTM Designation D 242	Standard Specification for Mineral Filler for Bituminous Paving Mixture

12.02 MATERIALS (Continued)

C. MINERAL AGGREGATES (Continued)

1. General (Continued)

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 non-coated particles, free from injurious quantities of clay, dust, soft or flaky particles, loams, shale, alkali, organic matter, or other deleterious material. Crushed rock shall be crushed limestone, granite, quartzite, or other ledge rock approved for the intended purpose by the City and shall not contain deleterious substances in a quantity exceeding three and one-half percent (3.5%) of any combination of shale, clay lumps, coal, or soft particles with shale and clay lumps not to exceed one and one-half percent (1.5%).

The absorption of water by crushed rock for use in asphaltic concrete shall not exceed three and two-tenths percent (3.2%) by weight.

The gradations from any one source shall be reasonably uniform. 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 Engineer. 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 percent by weight at the end of 5 cycles using sodium sulfate solution.

The mineral aggregate may be tested prior to its use. Generally only mineral aggregates that have been used for similar work and have satisfactory service records will be approved. If, in the opinion of the Engineer, the mineral aggregate warrants further testing, the sampling and testing will conform to the following requirements:

ASTM C 127	Specific Gravity & Absorption of Coarse Aggregates.
ASTM D 75	Standard Practice for Sampling Aggregates.
ASTM C 136	Standard Test Method for Sieve Analysis of Fine & Coarse Aggregates.
ASTM D 546	Standard Test Method for Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures.
ASTM C 128	Specific Gravity & Absorption of Fine Aggregates.
ASTM C 131	Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion Impact in the Los Angeles Machine.
ASTM C 88	Standard Test Method for Soundness of Aggregate.
ASTM D 693	Standard Spec. for Crushed Aggregate for Macadam Pavements.

12.02 MATERIALS (Continued)

C. MINERAL AGGREGATES (Continued)

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:

Total Percent Passing:	Minimum	Maximum
# 50 (300 µm) Sieve	95	100
# 200 (75 µm) Sieve	80	100
Plasticity Index [material passing #200 (75 µm)]	0	3
Plasticity Index for Soil	0	6

D. NON-WOVEN PAVEMENT OVERLAY FABRIC

Non-woven overlay fabric shall be needle punched, polypropylene fabric conforming to the following requirements:

PROPERTY	TYPICAL	MINIMUM
Mass, g/m^2	145	129
Tensile Strength, newton (N)	512	400
Elongation at Break, %	60	55
Mullen Burst Strength, kPa	1515	1375
Asphalt Retention, L/m^2	----	0.90

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

12.03 ASPHALTIC CONCRETE MIXTURES

A. GENERAL

Asphaltic concrete mixtures shall be designed by the Contractor, according to the Asphalt Institute Superpave Mix Design Series No. 2 (SP-2), to meet the Mix Design Criteria for the appropriate mix class as shown in these specifications.

The Contractor will be required to define properties using a gyratory compactor, that has met the Superpave evaluation test procedures, according to the gryation levels indicated in Table 12.01 for the mix type specified.

Unless otherwise specified or approved by the Engineer, Asphaltic Concrete for Arterial Street Mix shall meet or exceed all of the requirements for Asphaltic Concrete type “SP4" as described in these specifications.

A. GENERAL (Continued)

Unless otherwise specified or approved by the Engineer, Asphaltic Concrete for Non Arterial Street Mix and Parking Area Mix shall meet or exceed all of the requirements for Asphaltic Concrete type “SP4 Special" as described in these specifications.

Unless otherwise specified or approved by the Engineer, the Blended Aggregate for Arterial Street Mix shall contain no more than 80 percent limestone and shall meet the requirements of Table 12.11, Gradation Control Points For 0.500 (½) Inch Nominal Size.

Unless otherwise specified or approved by the Engineer, the Blended Aggregate for Non Arterial Street Mix shall contain no more than 80 percent limestone and shall meet the requirements of Table 12.11, Gradation Control Points For 0.375 (3/8) Inch Nominal Size.

Unless otherwise specified or approved by the Engineer, the Blended Aggregate for Parking Area Mix and temporary pavement mixes shall contain no more than 80 percent limestone and shall meet the requirements of either Table 12.11, Gradation Control Points For 0.500 (½) Inch Nominal Size or Table 12.11, Gradation Control Points For 0.375 (3/8) Inch Nominal Size.

Table 12.00 is a summary of the general mix requirements for the standard City of Lincoln asphalt mixes. Actual design and material criteria are described in following sections of this specification. Deviation from these requirements must be approved by the Engineer.

Table 12.00
ASPHALTIC CONCRETE MIX REQUIREMENTS SUMMARY

	Arterial Street	Non Arterial Street	Parking Area
Superpave Level	SP4	SP4 Special	SP4 Special
PG Binder Grade *	70-28 Polymer Mod.	70-28 Polymer Mod.	64-22
Gradation Band **	1/2"	3/8"	1/2" or 3/8"
Compaction Min. ***	92.5%	92.5%	92.5%

* Binder grade for temporary asphalt pavement and patching areas shall be PG 64-22 or as approved by the Engineer.

** Applies to surface lift, lower lifts in full depth asphalt pavement may use 3/4" band if approved by the Engineer.

*** Required for 100% pay.

B. VOLUMETRIC MIX DESIGN

The mix formula shall be determined by the Contractor from a mix design for each mixture. A volumetric mixture design in accordance 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.

The following test procedures shall apply:

AASHTO R 30 -	Practice for Short and Long-Term aging of Hot Mix Asphalt
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 accordance with AASHTO T 209.

Each Superpave mixture shall be tested by the Contractor for moisture susceptibility in accordance with AASHTO T 283. The loose mixture shall be short-term aged for two hours in accordance with AASHTO R30. The 6-inch specimens shall be compacted in accordance with AASHTO T 312 to 7 percent air voids at 95-mm in height and evaluated to determine if the minimum Tensile Strength Ratio (TSR) of 80 percent has been met. If the mixture has not met the minimum TSR value, a liquid anti-stripping additive shall be 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 percent. All data shall be submitted with the mix design for approval. During production, the Contractor may be required by the Engineer, to provide and test additional specimens of the plant produced asphaltic concrete for moisture susceptibility. A TSR test result of less than 80 percent 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 percent is achieved.

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

C. 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 of Lincoln Materials Testing Laboratory. 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 shall also be submitted to the City 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 Testing Lab, 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. 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 of each aggregate
- The bulk specific gravity of the blended aggregate (To be determined from the combined blend on the - #4 and the + #4 sieves in accordance 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

When recycled mixes are specified, the Contractor shall submit a 65 pound sample of the reclaimed asphalt pavement (RAP) with the samples of virgin aggregates as described above, for determination of asphalt binder content, gradation and bulk specific gravity of RAP material. RAP material that is not reasonably uniform in asphalt binder content and gradation shall not be used in City of Lincoln projects. The Contractor shall include with the mix design of recycled mixes the percent of added asphalt binder and the total asphalt binder percent. Recycled mixes shall contain no more than 15% RAP by total weight of mix.

During production, asphaltic concrete shall be sampled and tested for quality by the City on a lot basis as defined in Chapter 5.06 paragraph C of these specifications. Tests shall include the following:

AASHTO T 209	Maximum specific gravity of the mix (Rice)
ASTM C 136	Standard Test Method for Sieve analysis of Fine and Coarse Aggregate
AASHTO T312	Method for Preparing and Determining the Density of Hot Mix (HMA) Asphalt Specimens by Means of the Superpave Gyratory Compactor
AASHTO T 166	Bulk Specific Gravity of compacted Bituminous Mixtures using saturated surface-dry specimens
National Center for Asphalt Technology	Asphalt binder content of total mix by ignition

D. MIX DESIGN CRITERIA

The design criteria for each mixture shall be determined from Tables 12.01, 12.02, 12.03, and 12.04.

The optimum binder content shall be the binder content that produces 4.0% +/- 1% air voids at Ndes for all mix types except type SPS where the optimum binder content shall be that which produces air voids at Ndes of 1.5% to 5.0%.

Table 12.01
GYRATORY COMPACTION EFFORT
Average Design High Air Temperature = < 39 degrees C (102° F)

Asphaltic Concrete Type	Nini	Ndes	Nmax
SPS	6	40	62
SP1	7	68	104
SP2, SP4 SPECIAL	7	76	117
SP3	7	86	134
SP4	8	96	152
SP5	8	109	174

Table 12.02
COMPACTION CRITERIA

Mix Criteria	SPS,SP1	SP2	SP3,SP4, SP4 SPECIAL,SP5
%Gmm at Nini (Max.)	91.5 *	90.5	89.0
%Gmm at Nmax (Max.)	98.0 *	98.0	98.0

*No specification requirement for SPS, only %Gmm at Ndes = 95.0 to 98.5

D. MIX DESIGN CRITERIA (Continued)

Table 12.03
VOIDS IN MINERAL AGGREGATE
Criteria at Ndes

Nominal Maximum Aggregate Size	Minimum VMA, Percent
3/8 (0.375) inch	15.0
½ (0.500) inch	14.0
3/4 (0.750) inch	13.0

Table 12.04
VOIDS FILLED WITH ASPHALT
Criteria at Ndes

Asphaltic Concrete Type	Design VFA, Percent
SPS	N/A
SP1	70 - 80
SP2,SP3	65 - 78
SP4,SP4 Special,SP5	65 - 75

If at the end of the day's production, either of the two following conditions occur, the Contractor will not be allowed to resume production until corrective adjustments are made to the mix design:

1. Air Voids, VMA, VFA, FAA, CAA or Binder content do not meet the currently approved criteria.

2. Rutting occurs.

Mix adjustments at the plant are authorized within the limits shown in Table 12.05 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 specifications.

All adjustments must be reported to the Engineer.

The adjustment values in Table 12.05 will be the tolerances allowed for changes indicated by production or mix design test results, but cannot deviate from Superpave gradation criteria.

D. MIX DESIGN CRITERIA (Continued)

Table 12.05
AGGREGATE ADJUSTMENT TOLERANCE

Aggregate Adjustments	
Sieve Size	Adjustment Range
1 inch, 3/4 inch, ½ inch, 3/8 inch	± 6%
No. 8, No. 16, No. 30, No. 50	± 4%
No. 200	± 2%

E. AGGREGATE CRITERIA

1Coarse 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 12.06.

Table 12.06
COARSE AGGREGATE ANGULARITY
(ASTM D 5821)

Asphaltic Concrete Type	CAA (minimum)
SPS	35
SP1	55
SP2	65
SP3	75
SP4,SP4 Special	85/80*
SP5	98/90*

* 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.

2. 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 12.07.

E. AGGREGATE CRITERIA (Continued)

2. Fine Aggregate Angularity (FAA) (Continued)

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 12.07
FINE AGGREGATE ANGULARITY
(AASHTO T 304 Method A)

Asphaltic Concrete Type	FAA (minimum)
SPS	N/A
SP1	40.0
SP2,SP3	43.0
SP4,SP4 Special,SP5	45.0

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.

3. 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 12.08.

Table 12.08
FLAT AND ELONGATED PARTICLES*
(ASTM D 4791)

Asphaltic Concrete Type	Percent, Maximum
SPS	25
SP1,SP2,SP3,SP4,SP4 Special,SP5	10

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

12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

E. AGGREGATE CRITERIA (Continued)

4. 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 12.09, shall be met or exceeded.

Table 12.09
CLAY CONTENT
(AASHTO T 176)

Asphaltic Concrete Type	Sand Equivalent, Minimum
SPS	30
SP1,SP2	40
SP3,SP4,SP4 Special,SP5	45

5. Gradation

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

For Superpave mixes where the FAA requirement is less than 45.0, the plot of the selected blended aggregate gradation shall not pass through the restricted zones as specified in the following control points for nominal size unless approved by the Engineer based on material characteristics.

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 0.6 and 1.6. This shall be verified during mix design approval and production sample testing.

12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

E AGGREGATE CRITERIA (Continued)

6. Gradation (Continued)

Table 12.10
GRADATION CONTROL POINTS FOR 0.375 (3/8) INCH NOMINAL SIZE

	Control Points (percent passing)		Restricted Zone Boundary (percent passing)	
Sieve	Minimum	Maximum	Minimum	Maximum
½ inch	100.0			
3/8 inch	90.0	100.0		
No. 4		90.0		
No. 8	32.0	67.0	47.2	47.2
No. 16			31.6	37.6
No. 30			23.5	27.5
No. 50			18.7	18.7
No. 200	2.0	10.0		

Table 12.11
GRADATION CONTROL POINTS FOR 0.500 (½) INCH NOMINAL SIZE

	Control Points (percent passing)		Restricted Zone Boundary (percent passing)	
Sieve	Minimum	Maximum	Minimum	Maximum
3/4 inch	100.0			
½ inch	90.0	100.0		
3/8 inch		90.0		
No. 8	28.0	58.0	39.1	39.1
No. 16			25.6	31.6
No. 30			19.1	23.1
No. 50			15.5	15.5
No. 200	2.0	10.0		

12.03 ASPHALTIC CONCRETE MIXTURES (Continued)

E. AGGREGATE CRITERIA (Continued)

6. Gradation (Continued)

Table 12.12
GRADATION CONTROL POINTS FOR 0.750 (3/4) INCH NOMINAL SIZE

	Control Points (percent passing)		Restricted Zone Boundary (percent passing)	
Sieve	Minimum	Maximum	Minimum	Maximum
1 inch	100.0			
3/4 inch	90.0	100.0		
½ inch		90.0		
No. 8	23.0	49.0	34.6	34.6
No. 16			22.3	28.3
No. 30			16.7	20.7
No. 50			13.7	13.7
No. 200	2.0	8.0		

12.04 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 following listed units of equipment shall conform to the requirements specified herein.

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 Engineer 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 Engineer 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 the use of an observer if deemed necessary by the Engineer.

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 Engineer. 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 250F and 350F 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

12.04 EQUIPMENT (Continued)

B. MIXING PLANT (Continued)

1. General (Continued)

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.

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 form 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. Pugmill Plants

a. General

Pugmill 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 pugmill blades shall have a minimum clearance of 3/4 inch 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

12.04 EQUIPMENT (Continued)

B. MIXING PLANT (Continued)

2. Pugmill Plants (Continued)

b. Batch Plants (Continued)

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 percent; and they shall be sensitive within 0.2 percent or 2 pounds, whichever is greater, throughout the range of use.

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 accordance 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 one-half percent (0.5%) of the total axle load or total load.

12.04 EQUIPMENT (Continued)

C. Truck Scales (Continued)

Scales shall be properly calibrated by the Contractor in the presence of the Engineer 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 a City of Lincoln representative. 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 ten (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 Engineer.

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 Engineer.

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.

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 marking or the on site crew supervisor shall have a current ATSSA (American Traffic Safety Services Association) or IMSA (International Municipal Signal Association) certification as a Pavement Marking Technician or Pavement Marking Specialist. A copy of certification shall be submitted to the Engineer prior to the beginning of the project.

The Contractor shall install pavement marking materials as specified on the plans and these specifications to provide quality reflectorized traffic pavement marking. When the date, temperature, or humidity conditions prevent the installation of the specified marking material, the Contractor shall install and maintain temporary paint marking or other traffic pavement marking approved by the Engineer, at the Contractor's cost.

The properties of each marking material, the type of pavement surface, and the manner of marking determine which types of marking material may be applied on each project.

13.01 NOT USED

13.02 MATERIALS

A. GENERAL

1. Certificate of Compliance

   The Contractor shall furnish manufacturer's certifications for each marking material to be supplied and to be used on the project. Certificates shall indicate compliance with the provisions of the Specifications.

2. Durable Marking Material

   Durable traffic pavement marking materials as used in this specification are materials which have a normal life of at least two years initial application. The following materials are considered durable marking materials:

   1. Preformed Plastic
   2. Thermoplastic (molten)
   3. Thermoplastic (preformed)
   4. Liquid Polyurea (two component)

13.02 MATERIALS (Continued)

B. PREFORMED PLASTIC

1. General

White and yellow preformed retroreflective plastic pavement marking materials shall be suitable for use as reflective pavement markings on portland cement concrete or asphaltic concrete. The preformed marking material shall be 60 mils thick, retroreflective, pliant polymer tape.

Preformed plastic marking material installed for crosswalks and stop-bars shall be State of Nebraska Department of Roads Type III (intersection grade) material.

Preformed plastic marking material installed for longitudinal lines, arrows, legends and gores shall be State of Nebraska Department of Roads Type IV (improved retroreflectivity retention) material.

The retroreflective plastic pavement marking material shall consist of a mixture of high quality plastic materials, pigments, and glass beads uniformly distributed throughout its base cross-sectional area, with a reflective layer of beads bonded to the top surface. The material shall be capable of conforming to pavement contours, breaks, faults, etc., through the action of traffic at normal pavement temperatures.

The material, when applied according to the recommendations of the manufacturer, shall provide a neat, durable marking that will not flow or distort due to temperature, provided the pavement surface remains stable. The material shall provide a cushioned, resilient substrate that reduces bead crushing and loss. The material shall be weather resistant, and through normal traffic wear, shall show no appreciable fading, lifting, or shrinkage throughout the useful life of the marking, and shall show no significant tearing, roll back, or other signs of poor adhesion.

Preformed legends and symbols shall conform to the applicable shapes and sizes as outlined in the current edition of the “Manual on Uniform Traffic Control Devices for Streets and Highways” (MUTCD).

2. Approved Material

The City reserves the right to conduct whatever tests are deemed necessary to identify and determine the quality, characteristics, and uniformity of any material. Preformed plastic pavement marking materials which have not been tested and given prior approval for the project by the Engineer will not be permitted on the project.

3. Adhesives

The preformed plastic material shall have a pressure sensitive, precoated, factory applied adhesive capable of adhering the materials to portland cement concrete or asphaltic concrete pavements. The material must be capable of being applied to pavement without the use of heat, solvent, activator, or additional adhesives. A primer may be used to precondition the pavement surface. Any primer necessary or recommended to precondition portland cement concrete or asphaltic concrete pavement shall be identified by the plastic material supplier. The adhesive shall permit repositioning of the preformed markings on the pavement surface before being placed in a final position by the application of pressure. The adhesive shall be a thin, non-asphaltic type which will not leave a noticeable residue on the pavement after the plastic material wears away. After application, the marking shall be immediately ready for traffic.

The adhesive surface of preformed plastic material precut to standard shapes, legends, or symbols shall be covered by a protective liner for the prevention of premature adhesion or contamination before application. Preformed plastic material supplied in rolls may be supplied with or without a protective liner on the adhesive surface. The protective liner shall be readily removable by peeling at the time of application.

C. THERMOPLASTIC - MOLTEN

1. General

White and yellow reflectorized thermoplastic (molten) pavement marking material shall be of a type that is applied only to asphaltic concrete 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 roadways or streets, or because of the content of pavement materials, and shall be impervious to oil and grease drippings from traffic. In the molten state, the material shall not give off fumes which are toxic or otherwise injurious to persons or property. The material shall not break down, deteriorate, scorch, or discolor if held at the molten temperature for a period of four (4) hours, or by reason of four (4) reheatings to the molten temperature. The temperature versus viscosity characteristics of the plastic

material shall remain constant through up to four (4) reheatings, or from batch to batch. The material shall be free from all skins, dirt, foreign objects, or such ingredients as will cause bleeding, staining, or discoloration.

2. Formula

The manufacturer shall have the option of producing the thermoplastic pavement marking materials according to the manufacturer's own formulas. Regardless of the formula used in the manufacture, the material shall contain not less than thirty percent (30%) by weight of glass beads, not less than eighteen percent (18%) by weight of resin binder. The white material shall have not less than ten percent (10%) by weight of titanium dioxide. The binder shall contain not less than eight percent (8%) by weight of maleic-modified glycerol ester resin. The filler shall be white calcium carbonate or equivalent with a compressive strength of 5,000 psi. The pigment, beads, and filler shall be evenly dispersed in the resin binder.

The yellow pigment for thermoplastic material applied to asphaltic concrete shall be double encapsulated lead chromate. The thermoplastic material must comply with Resource Conservation and Recovery Act (RCRA) Federal Standard of 5 mg/L maximum lead content as determined by Toxicity Characteristic Leaching Procedudre (TCLP) evaluation.

3. Suitability

The thermoplastic material shall be a product especially compounded for traffic markings. The markings shall not show appreciable deformation or discoloration under normal traffic conditions at temperatures below 140° F. Markings shall have a uniform cross-section. The density and character of the material shall be uniform throughout its thickness. The stripe shall maintain its original dimensions and placement.

The exposed surface shall be free from tack and shall not be slippery when wet. The material shall not lift from the pavement in freezing weather. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping or cracking. When applied at the maximum bond temperature certified by the material manufacturer and thickness of 125 mils, the material shall set to bear traffic in not more than five minutes when the air temperature is 50° F, and not more than fifteen minutes when the air temperature is 90° F. The thermoplastic material shall readily extrude at temperatures below 450° F from the equipment used to produce a cross-section of line 125 mils thick which shall be continuous, uniform in shape, and have clear and sharp dimensions.

13.02 MATERIALS (Continued)

4. Reflectorization

During manufacture, reflectorizing glass beads shall be mixed into the material to the extent of not less than thirty percent (30%) nor more than forty percent (40%) by weight of material.

5. Physical Requirements of Material

a. Color: White

As demonstrated by a standard color difference meter, the white thermoplastic material shall show deviations from a magnesium oxide standard not greater than the following after the material has been heated for four hours at 425°:

Reflectance (Rd)	75% Minimum
Redness-Greenness (a)	0 +/- 5%
Yellowness-Blueness (b)	0 +/- 10%

White thermoplastic material shall contain a minimum of 10% titanium dioxide by weight and, after setting, shall be pure white and free from dirt or tint.

Color: Yellow

The color of the yellow thermoplastic material shall visually match Federal Test Standard Number 595-Color 13538. The daytime reflectance shall be forty-five percent (45%) minimum.

b. Color Retention

Retention of the initial color shall be determined by exposing a test specimen to an ultra-violet light source similar to a General Electric 275-watt sun lamp, type RS, with a built-in reflector. After one hundred (100) hours of exposure the test specimen shall show no perceptible color change (as indicated by comparison with an unexposed specimen).

c. Water Absorption

Material shall have not more than one-half percent (0.5%), by weight, of retained water when tested by “Standard Test Method for Water Absorption of Plastic” ASTM D 570/D 570M, procedure (A).

13.02 MATERIALS (Continued)

d. Softening Point

Material shall have a softening point of not less than 200° F after the material has been heated for four (4) hours at 425° F, as determined by "Standard Test Method for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus" ASTM E 28/E 28M.

e. Specific Gravity

Specific gravity of thermoplastic compound at 77° F shall be from 1.6 to 2.15.

f. Impact Resistance (IZOD)

Impact resistance shall not be less than 10 inch-pounds at 77° F after the material has been heated for four (4) hours at 425° F and cast into bars of 1 inch cross-sectional area, 3 inches long and placed with 1 inch extending above the vise in a cantilever beam (IZOD Type) tester using the 25 inch pound scale. This device is described in "Standard Test Methods for Determing the Izod Pendulum Impact Resistance of Plastics" ASTM D 256.

For application to asphaltic cement concrete pavement without sealer or primer, impact resistance shall be not less than 11 inch-pounds when tested in accordance with "Standard Test Methods for Determing the Izod Pendulum Impact Resistance of Plastics" ASTM D 256. When tested by the Gardner Falling Weight method, impact resistance shall be not less than 80 inch-pounds with no visible surface cracks after the material has been heated for four (4) hours at 425° F and applied to a portland cement concrete block, allowed to cool and tested in accordance with "Standard Test Method for Impact Resistance of Flat Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)" ASTM D 5420, Section II.

g. Flowability

After heating four (4) hours at 425° F , the material shall have a maximum flow residue of eighteen percent (18%). After heating for two (2) hours and subsequently stirring for six (6) hours at two hundred revolutions per minute (200 rpm) at 425° F, the material shall have a maximum flow residue of twenty-eight percent (28%).

13.02 MATERIALS (Continued)

h. Bond Strength

When two concrete blocks, 2 x 3 ½ x 7 inches are bonded together on the 3½ x 7 inch faces with a 1/16 inch to 1/8 inch layer of the thermoplastic pavement marking material together with any primer that is to be used in field application and tested in accordance with "Standard Test Method for Bond Strength of Thermoplastic Traffic Marking Materials" ASTM D 4796, the bonded strength shall be not less than 180 psi. The material must also retain a 180 psi minimum bond strength when tested by the Freeze-Thaw Test (Texas Transport Institute Method).

The application to asphaltic concrete pavement without sealer or primer, minimum bond strength shall be not less than 275 psi when tested in accordance with "Standard Test Method for Bond Strength of Thermoplastic Traffic Marking Materials" ASTM D 4796.

i. Indentation Resistance

The material when tested with a Shore Durometer, Type A2, in accordance with "Standard Test Method for Rubber Property - Durometer Hardness" ASTM D 2240, shall have hardness readings not less than the amounts specified below when tested for fifteen (15) seconds using a 2 pound weight after heating for four (4) hours at 425° F and cooled to the following temperatures:

At 115° F, the reading for asphaltic pavement shall be 65 +/- 2%. At 77° F, the reading shall be 95 +/-2%.

j. Abrasion Resistance

The material shall show a maximum loss of one-half (0.5) gram when subjected to two hundred (200) revolutions on a Taber abraser at 77° F, using H-22 calibrase wheels weighted to 1.2 pounds. The wearing surface should be kept wet with distilled water throughout the test. The panel for this test shall be prepared by forming a representative lot of material at a thickness of 1/8 inch on a 4 inch square model panel by 0.05 inch thick on which a suitable primer has been previously applied.

k. Low Temperature Stress Resistance

For application to asphaltic concrete pavement without sealer or pimer, the material shall show no cracking when tested according to AASHTO T250, Section 7 with Section 7.2.3 modified for an extended cold temperature (15° +/- 3° F) exposure period of 72 hours.

6. Approved Material

The City reserves the right to conduct whatever tests are deemed necessary to identify and determine the quality, characteristics, and uniformity of any material. Thermoplastic (molten) pavement marking materials intended for application to aged asphaltic concrete pavement without sealer or primer, and which have not been tested and give prior approval for the project by the Engineer, will not be permitted on the project.

D. THERMOPLASTIC PREFORMED

1. General

White and yellow thermoplastic (preformed) marking material shall be a preformed, retroreflective, thermoplastic pavement marking material which, when applied to portland cement concrete or asphaltic concrete and properly heated to 400° F with a propane torch, will provide a durable, reflective pavement marking. The material must be able to be applied in temperatures down to 32° F without any preheating of the pavement to a specific temperature or any special storage, preheating, or treatment of the material before application. The preformed material shall be 90 mils thick.

When applied to portland cement concrete surfaces use a manufacture approved 2-part epoxy agent. Apply the binding agent according to the manufacture's recommendation.

The material shall consist of a mixture of ester modified resin, aggregates, pigments, binders, and glass beads uniformly distributed throughout its base cross-sectional area, with a layer of reflective beads bonded to its top surface. The material shall be capable of conforming to pavement contours, breaks, and faults through the action of traffic at normal pavement temperatures. The material shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic material when heated with a torch.

The markings must be resistant to the detrimental effects of motor fuels, lubricants, and hydraulic fluids. The material shall conform to AASHTO designation M249, with the exception of the relevant differences due to the material being supplied in a preformed state.

Preformed legends and symbols shall conform to the applicable shapes and sizes as outlined in the current edition of the MUTCD.

13.02 MATERIALS (Continued)

2. Physical Requirements of Material

a. Color: White

Sufficient titanium dioxide pigment is used to ensure a color similar to Federal Highway White, Color No. 17886, as per Federal Standard 595.

b. Color: Yellow

Sufficient yellow pigment is used to ensure a color similar to Federal Highway Yellow, Color No. 13655, as per Federal Standard 595. The yellow pigment must be an organic nature only and contain no lead chromate.

c. Reflectorization

(1) Intermixed glass beads

The material shall contain not less than thirty percent (30%) by weight of intermixed graded glass beads.

(2) Surface glass beads

The material shall have a factory applied, top surface coating of glass beads at a rate of 9 pounds per 100 square feet.

d. Heating Indicators

The top surface of the material shall have regularly spaced indents which shall act as an indicator system for the operator to properly gauge the correct amount of heat to apply during installation of the material. The indents shall work by closing together when the material has been heated to the correct molten state.

e. Skid Resistance

The surface of the material shall provide a minimum resistance value of 50 BPN when tested according to "Standard Test Method for Measuring Surface Frictional Properties using the British Pendulum Tester" ASTM E 303.

3. Approved Material

The City reserves the right to conduct whatever tests are deemed necessary to identify and determine the quality, characteristics, and uniformity of any material. Preformed thermoplastic pavement marking materials which have not been tested and given prior approval for the project by the Engineer will not be permitted on the project.

E. LIQUID POLYUREA - TYPE I

1. General

a. Type I markings consist of transverse markings, crosswalks, and symbols. The material shall be 3M Liquid Pavement Marking 1500 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.

2. Materials

a. Polyurea

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 ployurea 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 polyurea coating shall contain pigments which enable the markings to conform to highway color standards.

b. Ployurea Properties and Testing

The retroreflective pavement markings shall consist of a mixture of high-quality resins, curing agent and pigments, with a reflective layer of glass beads bonded to the top surface.

The markings shall consist of white and 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 8 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 drying time shall not increase substantially with decreasing temperature.

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.

c. Reflective Media Properties

The reflective media shall be comprised of glass beads capable of being applied onto the polyurea coating with good and even uniformity by appropriate particle coating equipment. The size and quality of the beads shall be such that the performance requirements for the markings shall be met. These beads, when properly applied at the specified coating weights will provide immediate and continuing retroreflection.

The required glass beads shall be a 90/10 blend (90% sinkers and 10% floaters) of AASHTO M247 Type 1 gradation 1.5 index glass beads.

Microscopic examination (20X) shall show no more than 15% of the beads having a formation of very distinct opaque white (corroded) layer on their entire surface.

d. Finished Markings

Because of normal variance in roads, application, and measurement, the properties of markings made from materials specified herein will vary from one installation to the next. When the materials are applied according to the specifications, they shall be capable of forming markings with the following reproducibility of properties.

When installed at 77 degrees and at a wet film thickness of 20+/- 2 mils with proper application, the marking shall reach a no-track condition in 8 minutes or less. Dry to “no-tracking” shall be considered as the condition where no visual deformation of the polyurea marking is observed when viewed from a distance of 50 feet, after a traveling vehicle’s tires have passed over the line. The drying time shall not increase substantially with decreasing temperature.

The surface of the retroreflective marking shall provide an initial average skid resistance value of 35 BPN when tested according to ASTM E303.

F. LIQUID POLYUREA - TYPE II

1. General

Type II materials consist of all longitudinal markings. The material shall be 3M Liquid Pavement Marking 1200 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 and composite reflective elements. The composite reflective elements shall contain microcrystalline ceramic beads bonded to an opacified ceramic core.

2. Materials

a. Polyurea

The components shall not contain appreciable amounts of volatile diluents. The polyurea coating shall be essentially a 100% solids product.

The polyurea coating materials shall be manufactured without the use of lead chromate pigments or other similar, lead-containing chemicals.

The white polyurea shall contain not less than 13% by weight rutile titanium dioxide pigment to ensure adequate opacity, hiding power and reflective properties.

b. Polyurea Properties and Testing

The preformed markings shall consist of white and yellow films with pigments selected and blended to conform to standard highway colors.

The mixed polyurea combined, both white and yellow, 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 be reasonably close to Federal Standard No. 595A-13538.

When tested in accordance with ASTM D711, 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.

The polyurea coating, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified concrete or asphalt surface that there shall be a 100% asphalt failure in the performance of this test. The prepared specimens shall be conditioned at 75 +/- 2 degrees for a minimum of 24 hours and maximum of 72 hours prior to the performance of the tests indicated.

c. Reflective Media Properties

The reflective media shall be made up of reflective elements and glass beads for drop-on application and shall conform to the following requirements.

The glass beads shall be a 60/40 blend (60% sinkers and 40% floaters) of AASHTO M 247 Type 1 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 procedure of ASTM D1213 and shall be a minimum of 30 pounds retained on US #40 Mesh.

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. 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.

The composite reflective elements shall be composed of a titania opacified ceramic core having clear and/or yellow tinted microcystalline ceramic beads embedded to the outer surface.

All microcrystalline ceramic beads bonded to reflective elements shall have a minimum index of refraction of 1.8 when tested using the liquid oil immersion method.

The size and quality of the beads shall be such that the performance requirements for the retroreflective material shall be met.

d. Finished Markings

Because of normal variance in road surfaces, application processes, and measurement, properties of markings made from the materials specified herein will vary from one installation to the next. When the materials are applied according to these specifications, they shall be capable of forming markings with the following reproducibility of properties.

When installed at 77 degrees F and at a wet film thickness of 15 +/- 1 mils, the markings shall reach a no-track condition where no visual deformation of the polyurea markings is observed when viewed from a distance of 50 feet, after a traveling vehicle's tires have passed over the line. The track-free time shall not increase substantially with decreasing temperature.

The average initial skid resistance shall be 45 BPN or greater when tested according to ASTM E303.

The initial retroreflectance <u>averaged</u> over a minimum of 10 location at each installation shall be at least 900 [mcd(ft^{-2})(fc^{-1})] for white and 700 [mcd(ft^{-2})(fc^{-1})] for yellow. The standard deviation of initial retroreflectance for many installations shall be no more than 130 [mcd(ft^{-2})(fc^{-1})] for both white and yellow.

The initial retroreflectance of a single installation shall be the average value determined according to the measurement and sampling procedures outlined in the ASTM D6359, using a 30-meter retroreflector meter. The 30-meter retroreflectometer shall measure the coefficient of retroreflected luminance, R_L, at an observation angle of 1.05 degrees and an entrance angle of 88.76 degrees. R_L, shall be expressed in units of millicandelas per square foot-candle [mcd(ft^{-2})(fc^{-1})].

Initial performance of pavement markings shall be measured within 7 days after application. The readings shall be delivered to the Engineer.

G. LIQUID POLYUREA - TYPE III

The specifications for this type of pavement marking material shall be the same as Liquid Polyurea - Type II except the composite reflective elements shall not be applied.

H. PAINT

White and yellow paint marking material shall be acrylic waterborne white and yellow traffic paint suitable for use as a reflective pavement marking on portland cement concrete or asphaltic concrete pavement when applied at temperatures of 50° to 150° F and 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.

The traffic paint shall conform to State of Nebraska Department of Roads “General and Detail Requirements for Acrylic Waterborne White and Yellow Traffic Paint”.

I. GLASS BEADS

1. General

Glass beads shall be Type 1, free flowing glass spheres suitable for use on pavement marking materials to provide reflectorized traffic pavement marking. The beads shall be transparent, clean, colorless glass, smooth, and spherically shaped, and free of imperfections of all types including film, scratches, pits, clusters, milkiness, or excessive air bubbles.

The beads shall have appropriate adherence and moisture resistant coatings to allow the beads to be properly embedded in the pavement marking material with sufficient capillary action to provide good anchorage and refraction.

2. Crushing Resistance

The average crushing resistance of glass beads shall be 40 pound dead weight for #20 to #30 sieve beads.

3. Roundness

A minimum of eighty percent (80%) of the beads of each sieve size shall be true spheres as determined by "Standard Test for Roundness of Glass Spheres" ASTM D 1155

4. Index of Refraction

The glass beads shall have a refractive index of not less than 1.50 when tested by the liquid immersion method at 77°.

5. Gradation

Glass beads intermixed in the thermoplastic material and glass beads dropped on the applied thermoplastic, epoxy, or paint material shall have the following gradations when tested in accordance with "Standard Test for Sieve Analysis of Glass Spheres" ASTM D 1214:

a. Intermixed glass beads (thermoplastic material)

SIEVE SIZE	PERCENT PASSING
#14	95-100
#16	80-95
#20	40-70
#40	0-10

b "Drop-on" glass beads

SIEVE SIZE	PERCENT PASSING
#14	100
#16	95-100
#20	10-50
#40	0-5

6. Chemical Resistance

The glass beads shall withstand immersion in water and acids without undergoing noticeable corrosion or etching and shall not be darkened or otherwise noticeably decomposed by sulfides. The test for chemical resistance shall consist of one (1) hour immersion in water and in solutions of corrosive agents followed by microscopic inspection. A three (3) to five (5) gram portion of the sample shall be placed in each of three (3) Pyrex-glass beakers or porcelain dishes; one sample shall be covered with distilled water, one with a 3N solution of sulfuric acid and the other with a 50% solution of sodium sulfide. After one hour of immersion, the glass beads of each sample shall be examined microscopically for evidence of darkening and frosting.

7. Flow Properties

The glass beads shall flow freely through the dispensing equipment in any weather suitable for marking.

J. RAISED PAVEMENT MARKERS

1. General

Markers shall consist of an acrylic plastic shell filled with a tightly adherent potting compound. The shell shall contain one or two prismatic retroreflective faces as required to reflect incident light form a single or opposite direction.

2. Design

The overall dimensions shall be 4 inches by 4 inches by 0.70 inches. The slope of reflecting face shall be 30 degrees to base. The area of each reflecting surface shall be 3.25 square inches.

The shell shall be molded of methyl methacrylate conforming to ASTM D788 Grade 8. The filler shall be a potting compound selected for strength, resilience, and adhesion adequate to pass physical requirements as outlined below.

The outer surface of the shell shall be smooth except for purposes of identification. The base of the marker shall be substantially free from gloss and substances that may reduce its bond to adhesive.

3. Optical Requirements

Horizontal entrance angle shall mean the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker. Observation angle shall mean the angle at the reflector between the illumination axis and the observation axis.

Coefficient of luminous intensity shall mean the ratio of the luminous intensity of the retroreflector in the direction of observation to the illuminance at the retroreflector on a plane perpendicular to the direction of the incident light.

For each lot consisting of 10,000 markers or less, select 20 markers at random for coefficient of luminous intensity check. Coefficient of luminous intensity of each retroreflecting surface shall be not less than shown in the following Table when the incident light is parallel to the base of the markers. Failure of more than 10% of the retroreflecting faces shall be cause for rejection of the lot.

COEFFICIENT OF LUMINOUS INTENSITY (SPECIFIC INTENSITY) REQUIREMENTS

Observation Angle (degrees)	Horizontal Entrance Angle (degrees)	Coefficient of Luminous Intensity (mcd/lux)					Specific Intensity (cd/ft)				
		White	Yellow	Red	Green	Blue	White	Yellow	Red	Green	Blue
0.2	0	279	167	70	93	23	3.0	1.8	0.75	1.0	0.28
0.2	20	112	67	28	37	10	1.2	0.7	0.3	0.4	0.11

A random lot of retroreflectors shall be tested. Specific intensity shall be measured at 100 feet test distance, spacing between source center and receptor center shall be 2.1 inches, receptor diameter and source diameter shall each be 1.0 inch. Other test distances 50 feet and above may be used provided that the angular aperture requirements are met.

4. Color

Color shall conform to the color requirements of ASTM D4280. Test method is provided in ASTM 4280.

5. Physical Properties

Markers conditioned to 73 +/- 4 degrees F shall support a load of 2000 pounds.

K. TUBULAR MARKERS

Flexible tubular posts shall be 4 feet in length, have a 2 1/4 inches outside diameter, with two 6 inch High Intensity reflective material sheets located 1 inch down from top and spaced 4 inches apart. The yellow tubular markers shall have yellow High Intensity reflective material sheets; the white tubular markers shall have silver. The markers shall be SAFE-HIT flexible Post System Part No. SH348SMA or approved equivalent.

Flexible tubular markers shall be attached to an adapter using a 3 inch by 5/16 inch grade II bolt and nylon locking nut. Adapters shall consist of 2 pieces of pipe welded together; the tops shall be even. One piece shall be 2 inches in length with a 2 1/4 inch inside diameter, and a 3/8 inch hole drilled 3/4 inch up from the bottom of the pipe, through both sides. The second piece shall be 6 inches in length with a 1 7/8 inch outside diameter. The pieces shall be welded together on both sides, forming a one piece unit.

13.03 INSTALLATION METHODS

A. GENERAL

The pavement upon which the pavement markings are to be placed shall be cleaned and prepared in a manner and to the extent recommended by the manufacturer, prior to placement of the markings. Cleaning shall be by any effective method, approved by the Engineer, that completely and effectively removes old pavement marking, contaminants, loose materials and conditions deleterious to proper adhesion.

New portland cement concrete pavement surfaces which have been open to traffic less than three (3) months shall be sandblasted, shot blasted or high-pressure water blasted to remove all latence and curing compound residue prior to installation of any pavement marking.

All pavement markings shall be installed in accordance with the material manufacturer's recommended application procedures or instructions.

All permanent or temporary pavement markings on new surfaces shall be installed on any segment of the roadway before that segment or roadway is opened to traffic.

All markings shall be pre-marked by the Contractor. The pre-marking shall be reviewed and approved by the Engineer prior to the application of any marking material. The Engineer will review the pre-marking on any City workday, if requested twenty-four (24) hours in advance.

When deemed necessary by the Engineer, the Contractor, at the Contractor's expense, shall place any additional temporary markings required to achieve alignment specified throughout both straight and horizontally curved sections of roadway. Any additional temporary markings placed on the roadway for alignment purposes shall not establish a permanent marking on the roadway. Materials used for alignment markings and equipment used to place such markings shall be approved by the Engineer.

The pavement markings shall be installed at the approved pre-marked alignment. Deviation from the approved alignment shall not exceed 1 inch, and the total of all deviations from the approved alignment shall not exceed 2 inches per 100 feet of roadway length.

Longitudinal pavement markings shall generally be offset at least 2 inches from construction joints.

B. PAVEMENT MARKING LAYOUT DESIGN

1. Longitudinal Marking

All longitudinal traffic pavement markings shall be white or yellow material placed in accordance with the pavement marking plan.

Lines shall be visually straight and shall have 4 inch or 8 inch overall widths as shown on plan. Skip lines shall be 4 inch wide material segments 6 feet in length separated by 18 foot gaps. Double yellow lines shall be two parallel 4 inch wide lines separated by a 4 inch space.

The traffic lane width and other transverse dimensions on the marking plan indicate the nominal distance from back of curb to center of marking line, and between centers of marking lines.

2. Transverse Marking

   Stop bars shall be 12 inch wide lines unless otherwise noted.

   Word and symbol marking, including letters and arrow, are considered transverse marking. Transverse marking layout shall comply with the current MUTCD).

3. Crosswalks

   Permanent crosswalks shall be "Continental" style, which is a series of 2 feet by 10 feet markings located generally parallel to the curb line. These markings shall have a gap between each other of not more than 5 feet. This spacing shall avoid the vehicle tire paths as much as possible. If there is a crosswalk on opposite sides of the intersection, the strips shall line up with each other.

4. Cross Hatching

   Cross hatching shall be 12 inched wide.

C. PERFORMED PLASTIC

Solid preformed plastic lines shall be applied to clean, dry pavement surface with a roll tape applicator capable of applying solid or continuous lines and broken or skip lines at regular intervals. Pavement primer or adhesive shall be used in accordance with material manufacturer's recommendations.

During preformed plastic marking installation, air temperature shall be a minimum of 60° F and rising, and pavement surface temperature shall be a minimum of 70° F and rising.

Preformed plastic marking material applied to asphaltic concrete surface shall be applied as soon as possible to the hot asphalt surface and inlaid by rolling with the steel finishing roller.

Crosswalks and stop bars shall be marked with State of Nebraska Type III material. Longitudinal lines, arrows, legends, and gores shall be marked with State of Nebraska Type IV material.

When preformed material is laid over construction joints, surface cracks 1/4 inch wide or greater, then the material shall be removed for a distance of 1/4 inch on each side of the joint or crack.

D. THERMOPLASTIC - MOLTEN

1. Pavement Preparation

   Dirt, grease, or any foreign materials that would reduce the adhesion of thermoplastic to the pavement must be removed by the Contractor before the application of thermoplastic material.

A moisture check shall be made each day prior to the application of the material by applying a thermoplastic line on a piece of tar paper (approximately 6 feet long) over the area to be marked. After thirty (30) seconds, visually inspect the underside of the tar paper. If the underside is wet, **do not** install the thermoplastic. If test fails, after one hour, perform test again.

2. Procedures

In no case shall thermoplastic (molten) pavement marking material to be applied when pavement or air temperatures are less than 50ºF unless otherwise approved by the Engineer.

Thermoplastic material must be installed at a thickness not less than 125 mils and shall not exceed 135 mils. The initial measurement should be made above the pavement surface. In some cases, however, primarily on fresh asphaltic concrete, the material may sink slightly into the pavement.

If the material appears to be less than 125 mils thick above the pavement surface, the line shall be 'chipped' and checked to determine the actual thickness. If the actual thickness is found to be less than 125 mils, the deficient portions of the line shall be ground down to no more than 30 mils above the pavement surface, and sufficient thermoplastic and glass beads placed over the line to bring it up to the specified thickness.

Existing painted pavement markings shall be removed prior to placement of the thermoplastic markings. Existing durable pavement markings shall be removed or prepared in a manner and to the extent recommended by the thermoplastic manufacturer, prior to placement of the new thermoplastic markings.

3. Equipment

Thermoplastic pavement marking material may be installed by the extrusion method or ribbon extrusion method.

Equipment used for placing markings shall be manufactured for that purpose and of sufficient size and stability to ensure a smooth and straight application of pavement marking.

A self-propelled, self-contained, riding type unit is required for longitudinal lines, unless approved by the Engineer. It must 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 follow pavement irregularities.

The Engineer may allow the use of a hand-operated or small riding machine where transverse markings or a limited quantity of edge and lane lines are required, provided sufficient traffic control is in place to close the lane adjacent to the marking operations.

4. Drop-on Beads

Immediate reflectivity is 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 dropped or sprayed into the material in a manner that will result in the surface beads being buried to about their midpoint. Glass beads shall be applied uniformly at a minimum rate of 10 pounds per 100 square feet. These beads are in addition to those that are provided as part of the thermoplastic mixture.

E. THERMOPLASTIC - PREFORMED

1. Pavement Preparation

Existing paint, epoxy, or preformed plastic pavement markings shall be removed prior to installation of thermoplastic pavement marking. Removal or preparation of existing pavement markings for the placement of the new thermoplastic marking shall be considered subsidiary to the pavement marking items.

The surface of portland cement concrete pavement and asphaltic concrete pavement must be dry when thermoplastic material is installed. To ensure that there is no moisture in the roadway surface, the surface of the pavement will be dried by heating the surface with a propane torch with flare nozzle until there is no change in color of the pavement surface resulting from evaporation of moisture. This surface drying procedure must be followed before every installation of preformed thermoplastic material, even if moisture is not expected in the roadway surface.

After drying the pavement surface, a primer sealer recommended by the thermoplastic material manufacturer shall be rolled onto the surface of all portland cement concrete pavement and al old asphaltic concrete pavement at the location to receive the marking. Asphaltic concrete will be treated as old pavement if the bitumen does not ‘sweat’ during the surface drying process. The primer sealer shall be allowed to dry tack free before the thermoplastic material is installed.

2. Procedures

Preformed thermoplastic material shall be installed in accordance with the material manufacture’s recommended instructions and procedures, and using equipment recommended by the material manufacturer.

Preformed thermoplastic material can be installed under any weather condition, provided moisture has been removed from the pavement surface. Approval of the Engineer is required before the material is installed when pavement or air temperatures are less than 32º F.

The material shall be installed using a propane torch heating procedure recommended by the material manufacturer. The material shall be installed, working a small area at one time, and heating the material with a sweeping action of a propane torch with flare nozzle until the material is melted enough to cause the heating indicators in the top surface of the material to close in and disappear.

The installed marking shall be protected from traffic until the material has cooled to the adjacent pavement temperature.

F. LIQUID POLYUREA - TYPE I

1. Application

The Contractor shall furnish equipment and apply the materials according to the following specifications.

a. Equipment

The equipment shall be capable of producing markings that meet the specifications contained herein using the materials specified in Section 13.02 E. Materials.

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.

At any time throughout the duration of the project, the Contractor shall provide free access to his application equipment for inspection by the Engineer, his or her authorized representative, or a materials representative.

b. Application Conditions

The markings shall only be applied during conditions of dry weather and when the pavement is dry and free of moisture. The road and air temperatures shall be above 40 degrees F and rising.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer.

Polyurea markings shall be placed in grooves as per Section 13.04.

The reflectorized pavement markings shall be placed only on properly prepared surfaces and at the widths and patterns as designated on the contract plans. The marking shall be applied in accordance with the current MUTCD and in accordance with the Engineer's plans.

The Engineer shall determine further restrictions and requirements of weather and pavement conditions necessary to meet all other application specifications and produce markings that perform to the satisfaction of the Engineer.

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, within 1-2 minutes after spraying the liquid onto the pavement surface, at 0.119 lb/ft^2. Application rates of the bead coating shall account for beads applied directly on binder.

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 the polyurea coating does not exhibit excessive overspray.

The Contractor shall ensure that the polyurea coating is well adhered to the road 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.

2. Inspection and Testing

During the application of the polyurea material, the Engineer may require the Contractor to verify application rate in conformance with the parameters required in this specification.

Equipment for applying material to the roadway 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 roadway 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 specification.

G. LIQUID POLYUREA - TYPE II

1. Application

The Contractor shall furnish equipment and apply the materials according to the following specifications:

a. Equipment

The equipment shall be capable of producing markings that meet the specifications contained herein using the materials specified in Section 13.1.02.

The equipment shall be a mobile, truck mounted and self-contained pavement marking equipment. It shall be designed to maintain a uniform rate of speed at increasing or decreasing road grades. The equipment shall be capable of air-blasting the pavement, spraying the mixed polyurea components, and dropping the reflective elements and glass beads in a single pass. It shall be capable to proportioning and mixing the liquid components continuously to ensure proper cure. The equipment shall be capable of heating and maintaining the heated temperature of the liquid components to enable mixing and spraying of the material.

At any time throughout the duration of the project, the Contractor shall provide free access to their application equipment for inspections by the Engineer, their authorized representative, or a materials representative.

b. Application Conditions

The markings shall only be applied during conditions of dry weather and when the pavement is dry and free of moisture. The road and air temperatures shall be above 40 degrees F and rising.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer.

Polyurea markings shall be placed in grooves as per Section 13.04.

The reflectorized pavement markings shall be placed only on properly prepared surfaces and at the widths and patterns as designated on the contract plans. The marking shall be applied in accordance with the current MUTCD and in accordance with the Engineer's plans.

The Engineer shall determine further restrictions and requirements of weather and pavement conditions necessary to meet all other application specifications and produce markings that perform to the satisfaction of the Engineer.

The polyurea coating shall be applied at rates to achieve 20-25 mils thickness.

The Contractor shall ensure that the beads and elements are properly set in the polyurea coating so that their exposed portions are free of polyurea coating material. The specified reflective media shall be dropped at rates to achieve 0.033 lb/ft^2 coating weight.

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 or uncured material. Typically, such areas will darken over time from dirt and tire residue.

The Contractor shall ensure the polyurea coating does not exhibit excessive overspray.

The Contractor shall ensure that the polyurea coating is well adhered to the road surface, and that the beads are well adhered to the binder.

The typical average initial retroreflectance of the markings shall be 900 mcd(ft^{-2})(fc^{-1}) for white and 700 mcd(ft^{-2})(fc^{-1}) for yellow.

The average initial retroreflectance shall be determined according to the measurement and sampling procedures outlined in ASTM D 6359, using a 30 meter retroreflectometer. The 30 meter retroreflectometer shall measure the coefficient of retroreflected luminance, R_L shall be expressed in units of millicandelas per square foot per foot-candle [mcd(ft^{-2})(fc^{-1})].

Initial performance of pavement markings shall be measured within 7 days after application.

c. Inspection and Testing

During the application of the polyurea material, the Engineer may request the following tests to verify application to the parameters required in this specification.

During appropriate locations along the alignment of the project site, the Engineer may obtain a sample of polyurea material applied onto a test card or silicone coated paper for the purposes of checking for proper binder thickness. The polyurea material shall be applied without reflective elements or glass beads. Upon cure of the binder material, the binder thickness shall be verified by the Engineer. The Contractor shall provide to the Engineer the application speed of the equipment during the time of the sample.

When required by the Engineer, the Contractor shall demonstrate to the Engineer the proper calibration of reflective elements and glass beads compared with the manufacturers requirement. The calibration shall be conducted with a graduated cylinder or other similar device. Reflective elements or glass beads shall be collected from the reflective element and glass beads shall be collected from the reflective elements and glass beads collected shall be measured and compare with the manufacturers requirements.

The Contractor shall provide to the Engineer at least one completed Application Card with typical binder and reflective media applied onto the surface. This Application Card will serve as a record of the project application conditions and settings. Application Cards are available from the manufacturer.

H. LIQUID POLYUREA - TYPE III

The installation method for this type of pavement marking material shall be the same as Liquid Polyurea - Type II except the composite reflective elements will not be applied.

I. PAINT

1. Pavement Preparation

The surface areas of portland cement concrete pavement and bridge decks that are to receive paint markings shall be sandblasted or shot blasted in the amount necessary to sufficiently removal all dirt, latence, and curing compound residue. Surface areas of asphaltic pavement and concrete pavement that are to receive paint markings shall be cleaned to remove dirt, grease, or any foreign material that would reduce 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. Painted lines shall have sharply defined edges at the overall line width shown on the plan.

Permanent paint marking shall not be installed at pavement, air, or paint temperature less than 50º F. Waterborne paint may be heated to a maximum of 150º 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 guns.

The Engineer 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 to produce a highly reflective, weather, and wear resistant traffic line.

13.03 INSTALLATION METHODS (Continued)

J. Raised Pavement Markers

The type of adhesive to be used shall be designated by the Contractor bearing in mind that the raised pavement marker shall remain bonded to the raised median for a period of 1 year from date of installation.

The marker shall have the reflector face positioned as designated by the Engineer.

The Contractor shall use a wire brush to remove all dirt, concrete sealants and paint, on the area where the Raised Pavement Marker is to be placed.

Surface preparation for installation of prismatic reflective pavement markers shall not be paid directly but shall be considered subsidiary to this item. Unsound pavement or other materials which could adversely affect the bond of the adhesive shall not be an acceptable surface.

K. Tubular Markers

Tubular markers that are installed in concrete medians shall be mounted on breakaway anchors made of steel. The anchors used shall be installed using Foresight V-loc or approved equivalent.

The Contractor shall be responsible for installing the anchor described in the LSP prior to installation of the concrete. No coring shall be allowed to install the anchor. In the event the anchor is not installed, the concrete shall be removed to the nearest joint and reinstalled with the anchor in place.

All installations shall have a new galvanized wedge installed, Part No. SW1 manufactured by Tapco or approved equivalent. The wedge shall be installed until tight.

In certain instances, if an adapter is not appropriate, a SAFE-HIT surface mounted base installed with epoxy, butyl pad, bituminous adhesive or approved equivalent must be used. This base shall remain bonded to the surface for a period of 1 year from date of installation.

13.04 GROOVED MARKING

Grooved marking consists of the installation of preformed plastic, thermoplastic (molten), thermoplastic (preformed), or polyurea 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.

All longitudinal or curved intersection grooved marking shall be premarked by the Contractor. All curved intersection markings in concrete shall be grooved. The pre-marking shall be reviewed and approved by the Engineer prior to the cutting of any grooves in the pavement surface.

13.04 GROOVED MARKING (Continued)

The grooves shall be cut into the pavement with a unit designed and developed to saw cut recessed grooves into pavement. The unit shall have a fully articulated cutter head design that follows the contour of the pavement surface and ensures proper cutting depth of the groove. All cut material shall be removed from the groove and the pavement surface.

The pavement marking tape shall be placed in the grooves the same day as they are cut. Grooves shall be clean and dry prior to tape application. All conflicting pavement markings remaining after tape installation shall be removed, this removal shall be subsidiary to the pavement marking.

Groove width:	Line width + 1 inch +/- 1/8 inch
Groove depth:	100 mils +/- 10 mils for 125 mils thick material
	45 mils +/- 10 mils for 60 mils thick material
	40 mils +/- 10 mils for 25 mils thick material
Groove length:	Marking material length + required grooving transition
Groove position:	Minimum of 2 inches from any joint line, where applicable

13.05 TEMPORARY MARKING

A. GENERAL

Temporary pavement marking may be used to provide guidance through construction work zones or to provide temporary pavement marking on completed roadways until date, temperature, or humidity conditions allow the installation of specified permanent marking material.

Temporary marking on completed roadways is normally provided by traffic paint, temporary marking tape, or raised pavement markers. 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 marking shall be at the Contractor's expense.

B. PAINT

Paint applied as a temporary marking shall generally comply with the paint material and installation method section of this Specification except for the pavement and air temperature restrictions.

13.05 TEMPORARY MARKING (Continued)

C. TEMPORARY TAPE MARKING

Temporary pavement marking tape shall be a retroreflective plastic material suitable for use as a temporary marking on portland cement concrete or asphaltic concrete pavement. 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. RAISED PAVEMENT MARKER

Raised pavement marker shall consist of a plastic shell having a minimum width of 4 inches and a maximum height of 0.79 inch with one or more prismatic reflective faces with a minimum of 0.38 square inches of reflective surface for each direction required to reflect incident light.

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.

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 a 18 foot gap between sets of markers.

Temporary raised pavement markers shall be removed by the Contractor when no longer needed.

13.06 REMOVAL

Existing traffic pavement markings which are in alignment with approximately the same location as proposed new pavement marking must be removed to the extent necessary to prepare the roadway surface for the installation of the new pavement marking material in accordance with these specifications and the material manufacturers recommendations. This type of pavement marking removal is considered part of pavement marking preparation and is not a separate pay item.

Existing traffic pavement marking which is NOT in alignment with the proposed new pavement marking, normally because of a change in pavement marking design or layout, must be removed to avoid conflicting marking. This type of marking will not be removed by the preparation of the roadway surface at the location of the proposed new marking. The removal of this marking is 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 Engineer. The removal method used should not significantly damage the pavement surface and should be determined after consideration of the type of marking material to be removed and the type of pavement surface. The pavement marking shall be removed to the satisfaction of the Engineer.

13.06 REMOVAL (Continued)

Any residue remaining after removal of the marking shall be collected and removed from the project by the Contractor.

At no time shall the depth of the groove exceed the depth specified in Section 13.04.

13.07 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pavement markings, grooved pavement markings, raised pavement markers, tubular markers, and temporary markings installed in conformance with the Plans and Specifications and acceptable to the Engineer shall be measured as actual material applied to the pavement and paid for at the contract unit price bid per linear foot or per each for the items of various types and 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.

The removal of existing pavement marking to allow a change in pavement marking layout, or location, and to remove conflicting marking shall be measured or counted and paid for at the Contract unit price bid per linear foot or each for the items of the various types and widths. Such payment shall be full compensation for removing and disposing of all material, and for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

13.08 GUARANTEE PERIOD

Following initial completion of all pavement marking, 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 Engineer determines is not performing satisfactorily. At the end of the observation period, the minimum required retention percentage for marking installed shall be 90% and shall met all millicandelas requirements for retroreflectivity 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 roadway 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 (each at least 80% complete) retained

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 other material listed above.

13.08 GUARANTEE PERIOD (Continued)

Marking replacement shall be performed in accordance with requirement specified herein for the initial application, including but not limited to surface cleaning and sealer or adhesive application.

When the Contractor is required to replace pavement marking material but the date, temperature, or humidity conditions do not allow the use of the permanent marking material, the Contractor shall install and maintain temporary paint marking or other traffic pavement marking approved by the Engineer until such time that the date, temperature, and humidity allow the installation of the permanent replacement marking material.

The installation, maintenance, and removal of the temporary pavement marking shall be the Contractor's expense.

Temporary pavement marking required by the Engineer shall be installed within one week of notification by the Engineer.

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 Engineer, shall be reapplied at no expense to the City.

Final acceptance of the pavement marking shall be 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. Said final acceptance shall be included in the guarantee.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 14

TRAFFIC SIGNS

ARTICLE	TITLE
14.00	General
14.01	Signs
	A. General
	B. Fabrication
	C. Installation and Removal
	D. Inspection and Warranty
	E. Method of Measurement and Basis of Payment
14.02	Mounting and Hardware
	A. “U” Channel Sign Posts
	B. Street Name Sign Posts
	C. Wood Poles
	D. Other Poles
	E. Method of Measurement and Basis of Payment
14.03	“U” Channel Posts
	A. General
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	D. Installation
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14.04	Street Name Sign Posts
	A. General
	B. Material
	C. Fabrication
	D. Installation
	E. Method of Measurement and Basis of Payment

CHAPTER 14

TRAFFIC SIGNS

14.00 GENERAL

This work shall consist of all materials and labor necessary to provide, fabricate, and install traffic signs at the locations shown in the plans.

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).

It shall be the Contractor's responsibility to utilize the "One-Call" system when required.

14.01 SIGNS

A. GENERAL

These signs are regulatory, warning, guide, object markers, and information signs composed of a flat aluminum blank surfaced with reflective sheeting. The message shall be either directly applied or screened on the sign face, in the colors, size, and layout specified in the plans and Standard Highway Signs.

Reflective background sheeting for all signs shall meet the requirements of ASTM D4956. The following types shall be used when specified: Type I for Engineering Grade, Type III for High Intensity, Type IX for VIP Grade. Refer to the LSP for required sheeting type. Adhesive shall conform to Class 1.

B. FABRICATION

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, and 9 square feet or greater shall be 0.10 inches thick.

Signs 18 inches tall or more (Metro Street Name signs) shall be 0.125 inches thick.

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.

The Contractor shall apply the reflective sheeting without visible seams or joints. Reflective sheeting shall be mechanically applied as per manufacturer's recommended procedures and equipment.

The message, legend, and border of signs shall be applied by either screening or electronic cutable (EC) film.

C. INSTALLATION AND REMOVAL

The bottom height of all signs shall generally be 7 feet above the ground or surface, unless otherwise specified in the MUTCD. If using a utility pole, the Contractor shall get approval from the appropriate pole owner to install a traffic control sign.

All signs on the roadway shall be mounted so that any edge of the sign which is adjacent to a roadway shall be a minimum of 2 feet from the face of curb. This distance shall be as close as possible to 2 feet from the face of curb.

The back of each sign shall have the month and year (MM/YY) that the sign was installed, in 1 inch black letters.

All signs that are installed shall have a fabrication date of no more than 6 months prior to the installation date and will not have been used previous to this installation.

The removal of the existing signs shall be coordinated with the Engineer to assure required signs are in place during all construction phases. These traffic signs, fastening hardware, and posts shall be returned to 901 North 6th Street. 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.

D. INSPECTION AND WARRANTY

Each sign installation will be reviewed by the engineer. If a sign does not meet the standards shown in this document, MUTCD, or the LSP, it shall be replaced or relocated at the Contractor's expense.

All Street Name sign layouts shall be reviewed and approved by City staff prior to fabrication.

Following initial completion of all traffic sign installations, there will be a 1 year observation period during which the Contractor, at no expense to the City of Lincoln, shall replace or reinstall any traffic sign that the Engineer determines is not installed properly or does not follow this specification.

E. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Signs shall be paid for at the contract unit price bid based on size. The three sign categories are small (signs less than 4 square feet), medium (4 square feet to less than 9 square feet), and large (9 square feet or larger). These bid amounts shall be full compensation for installing a new sign, 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 Specifications. Signs that are constructed from the fluorescent yellow green (FYG) material shall be paid for at a separate contract unit bid price per sign. .

14.01 SIGNS (Continued)

Removal of signs shall be paid for at the contract unit price bid 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 signing, post, 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 Specifications.

Relocated signs 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.

14.02 MOUNTING AND HARDWARE

A. "U" CHANNEL SIGN POSTS

The Contractor shall use 5/16 inch Grade 5 cadmium plated bolts of appropriate length and nuts with a 5/16 inch cadmium plated washer. A nylon washer between the steel washer and sign face shall be used.

B. STREET NAME SIGN POSTS

The Contractor shall refer to the LSP to install the Street Name assembly. All hardware shall be Lyle E450 or approved equivalent.

When installing two 6 inch signs, the North/South Street shall be installed on top. When installing three 6 inches signs, the signs shall alternate, with each sign being perpendicular to the next. When installing one 9 inch and one 6 inch sign, the 9 inch sign shall be on top. If there is NO "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.

If there is an additional sign below the Street name signs, the Contractor shall use a Pelco U-bolt Sign Clamp, SH-0206 or approved equivalent. A nylon washer shall be against the sign face to attach the sign.

C. WOOD POLES

The Contractor shall use 2 inch by 5/16 inch cadmium lag bolts and cadmium plated washer. A nylon washer shall be 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. The Contractor shall drive the lag bolts in half way with a hammer and then screw in until tight.

D. OTHER POLES

The Contractor shall use stainless steel Band-It banding, 3/4 inch 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.

14.02 MOUNTING AND HARDWARE (Continued)

E. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

All mounting materials used are subsidiary to installing the sign and shall not be paid for separately.

14.03 "U" CHANNEL SIGN POSTS

A. GENERAL

The post shall be "U" in shape and be the appropriate length and weight. If the post is 8 foot long it shall weigh 1.5 pounds per foot; if 9 foot long, it shall weigh 2.5 pounds per foot. If the post is 11 foot long, it shall weigh 2 pounds per foot; if 12 foot or longer, it shall weigh 3 pounds per foot.

B. MATERIAL

Posts shall be fabricated from hot-rolled steel conforming to the requirements specified in ASTM A 499 for Grade 60 steel, and conform to the chemical requirements specified in ASTM A 1 from rails having nominal weights of 90 pounds per yard and heavier when manufactured.

The ground sleeve shall be Foresight 19-VR18 or approved equivalent.

C. FABRICATION

The posts shall have holes from end to end. All holes shall be ⅜ inch diameter which shall be punched, with a spacing of one inch from center to center, +/- 1/16 inch, beginning with the first hole at one inch from the top of the post.

The punching shall be done so that there will be no cracks radiating from the holes.

All posts shall be cleaned of all loose scale prior to finishing and painted with one or more coats of green alkyd resin, gloss enamel baked on or approved equivalent. This finish shall produce a glossy appearance with satisfactory elastic and adhering properties of not be less than l.5 mils in thickness.

After drying, the finish shall not crack or chip from the metal when struck a light blow with a hammer. It shall show no appreciable change in adhesion or appearance when immersed in water at room temperature for a period of 72 hours.

D. INSTALLATION

The 9 foot posts that are installed in concrete medians shall be mounted on breakaway ground sleeves made of steel.

The Contractor shall be responsible for installing the ground sleeve described in the LSP 78 prior to installation of the concrete. No coring shall be allowed to install the ground sleeve. In the event the ground sleeve is not installed, the concrete shall be removed to the nearest joint and reinstalled with the ground sleeve in place.

The 11 foot posts shall be installed 2 feet 6 inches into the ground. The 12 foot posts shall be installed 3 feet into the ground.

14.03 "U" CHANNEL SIGN POSTS (Continued)

The Contractor shall use U-channel posts except for street name signs. All signs shall be mounted such that there is no extra post above the sign.

E. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment for installation of the posts shall be made for the measured quantity at the contract bid price per linear foot. These bid amounts shall be full compensation for 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 Specifications.

Payment for installation of the ground sleeve shall be made for the measured quantity at the contract bid price. The bid amounts shall be full compensation for the ground sleeve and for all labor, equipment, tools, materials, and incidentals necessary to complete the work in accordance with the plans and these Specifications.

14.04 STREET NAME SIGN POSTS

A. GENERAL

This specification describes the minimum acceptable requirements for round sign posts with anti-rotation wing, as per the LSP, used for the installation of street name signs. Posts shall be the appropriate length with one piece wing welded to the round pipe.

B. MATERIAL

The posts shall be fabricated from new, round, ASTM tested, 2-inch I.P.S. black pipe. The post wings shall be 1/4-inch thick high strength metal.

The Street name brackets can be seen in the LSP.

C. FABRICATION

The round post shall have a wing welded at a distance of 26 inches to bottom of wing from one end of the post.

The wing shall be formed from a 12-inch by 4-inch by 1/4 - inch thick piece of flat metal, bent to the radius of the pipe at the center of the 12-inch length, to provide two wings at 90 degrees from each other, and extend approximately 5 inches from the centerline of the pipe. The wing shall be welded to the pipe with a high strength, full length, continuous fillet weld, along all exposed contact points between the pipe and wings.

All ends, edges, and welds of the pipe and wings shall be smooth and free of sharp edges or burrs which could injure the hands of a person handling the post.

The posts shall be powder painted gloss black with a high quality enamel paint.

D. INSTALLATION

The Contractor shall use round posts when installing street name signs, which shall be installed 2 feet, 6 inches into the ground.

The posts shall be 10 foot long if there is no “Stop” sign to be installed. If there is a “Stop” sign to be installed, the post shall be 12 foot long. The post shall be 13 foot long if there is a “Stop” sign and two “One-Way” (back to back) signs installed.

E. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment for installation of the posts shall be made for the measured quantity at the contract bid price per linear foot. These bid amounts shall be full compensation for the anti-rotation wing, all labor, equipment, tools, materials, and incidentals necessary to complete the work in accordance with the plans and these Specifications.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

CHAPTER 15

TRAFFIC CONTROL

ARTICLE	TITLE
15.00	General
15.01	Traffic Control Plan
15.02	Traffic Control Supervisor
15.03	Traffic Control Diary
15.04	Traffic Control Devices
15.05	Traffic Control Flagging
15.06	Access to Adjacent Properties
15.07	Opening to Traffic
15.08	Method of Measurement and Basis of Payment
15.09	Non-compliance
15.10	Dynamic Message Signs

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 accordance 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) 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 (7:00-8:30 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 during all operations. All traffic control and traffic control devices required for any operation shall be functional and in place prior to the commencement of that operation. Signs for temporary operations shall be removed from view during periods of inactivity. The Contractor is required to maintain the project in a manner that is safe to the traveling public and which will not impede vehicles or pedestrians.

15.01 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 must meet or exceed the LTCG 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.
- Construction scheduling and hours of work.
- Flagging.
- Methods and devices for delineation and channelization.

15.01 TRAFFIC CONTROL PLAN (TCP) (Continued)

- 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 the review by the Engineer 1 week prior to proposed work beginning. No phase of construction shall commence until the TCP has been approved with the Engineers signature. The approved TCP shall not be revised without prior approval of the Engineer. TCP revisions shall be submitted a minimum of 3 City business days prior to implementation.

TCPs shall include detailed signing, barricading, 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 copies to the Traffic Engineer, Project Manager, Project , and TCS.

The work shall not begin until the approvals have been given and the approved TCP is on the project site. Once the project has begun, the TCS must ensure that the plan is followed throughout the project.

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 Engineer.

Should the Contractor fail to maintain the work within the specified limits, the Engineer 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 Engineer on a daily basis.

15.02 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 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 insure 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.
- Insuring that Traffic Control Devices are functioning as required including periodic nighttime inspections.
- Assuring that proper maintenance is being performed on the traffic control devices.
- Advising the Contractor of all deficiencies.
- Reporting to the Engineer 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 Engineer of recommended changes in the TCP. An effort will be made by the Engineer to obtain accident reports prepared by law enforcement officers having jurisdiction in the project area. This data will be utilized in evaluating the TCP.
- Overseeing all requirements covered by the TCP which contribute to the convenience, safety and orderly movement of traffic.
- Keeping Engineer informed of the apparent adequacy and effectiveness of the traffic control items on the project.
- Submitting documents including the Traffic Control Diary.

15.03 TRAFFIC CONTROL DIARY (TCD)

A Traffic Control Diary (TCD) is a daily record of events for the project. 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; roadway 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 with the engineer or their representative 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. The daily entries shall be signed by the Traffic Control making the entry.

At the completion of the project, the TCD shall be given to the Engineer 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 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 Engineer's approval. The Contractor shall maintain a stock of spare lights, signs, devices, and repair parts at the project site for immediate emergency replacement or repairs.

The Contractor shall remove conflicting permanent pavement markings as shown in the plans or as required by the Engineer. Temporary markings no longer needed shall be removed prior to opening to traffic.

Upon completion of the work in the vicinity of the previously removed Traffic Control Devices, the Contractor shall reinstall the devices as they were. 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 prove if any devices were damaged 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.

The Contractor shall mow or trim vegetation to insure that the complete visibility of signs, barricades, and other warning devices is maintained 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 in an approved manner, to secure all devices in an position for the public to observe.

15.05 TRAFFIC CONTROL FLAGGING

IMSA or ATSSA Certified flaggers are required.

Traffic movements through temporary lane closures on roads 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 roadway. 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 accordance with the requirements of the MUTCD.

15.06 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 Engineer and approved prior to implementation. The Contractor shall minimize the duration of access restrictions.

15.07 OPENING TO TRAFFIC

Before opening any portion of the public streets to vehicles or pedestrians, the Contractor shall restore the pavement, reset all signs, and restore all pavement markings. If necessary, a temporary surface and temporary pavement markings shall be placed as per the Engineer at the Contractor’s expense.

15.08 METHOD OF MEASUREMENT AND 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 for "Traffic Control for Construction."

LUMP SUM: When Traffic Control is shown as a Lump Sum item in the bid schedule, it shall be the responsibility of the Contractor to determine 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.

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 accordance with the plans or as directed by the Engineer.

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 roadway that are not necessary for proper traffic control.

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, and 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 III barricades shall be measured for payment by the number of calendar days each Type III barricade is in place and positioned as shown in the plans or as directed by the Engineer. Lighting on barricades is required and included in the cost of barricades.

Type II Barricades shall also include the use of reflectorized drums or vertical panels. 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.

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.

15.08 METHOD OF MEASUREMENT AND BASIS OF PAYMENT (Continued)

Flagging will be measured for payment for each flagger location on a daily basis. Operation of one flagger for 4 hours or less will be considered as one-half 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. The pay item Relocate Concrete Protection Barrier applies to repositioning the concrete protection barrier for subsequent phases of construction. These relocations shall be measured by the length of the concrete barriers so relocated based on the nominal length of the individual units.

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 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.

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.

Pavement Marking Removal shall be measured by the linear foot along the line for each permanent (not “temporary”) line removed.

Grabber Cones and Tubular Markers are measured by the maximum amount in use at any one time. Cones used that are less than 42" in height will not be paid for, but shall be subsidiary. The repositioning, re-attachment, removal, and/or replacement of a cone or tubular marker is subsidiary to the pay item.

15.09 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 Engineer, 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 Engineer 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 Engineer may also suspend all other work until the problem is corrected. The Engineer may elect at any time to correct a traffic control deficiency and bill the Contractor for all costs necessary to correct the problem.

15.09 NON-COMPLIANCE (Continued)

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 percent of the total contract amount for Traffic Control.

15.10 DYNAMIC MESSAGE SIGNS

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 Engineer. 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 Engineer. All messages displayed on the signs shall be approved by the Engineer.

The Contractor shall check messages at least twice per day to verify the message is readable and accurate.

High visibility cones shall be placed at each corner of the DMS when it is in or near the roadway.

Basis of Payment for Dynamic Message Sign shall be a fixed cost item and will be paid at the set contract unit price per day for the each item. Such payment shall be full compensation for furnishing, placement, maintenance, removal and all other incidentals required to provide fully operational DMS.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 20

CONSTRUCTION FOR UTILITIES AND STRUCTURES

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20.01	Related Items Specified Elsewhere
20.02	Materials
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	A. Clearing & Grubbing B. Tree Removal C. Excavation D. Backfill E. Maintenance and Protection of Excavations F. Disposal of Surplus Material G. Soil Erosion Control
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	A. Boring B. Casing Pipe

ARTICLE	TITLE
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CHAPTER 20

CONSTRUCTION FOR UTILITIES AND STRUCTURES

20.00 GENERAL

Construction for utilities and structures shall include the excavation of all materials necessary to complete the work in accordance with the plans and these 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 Specifications shall apply to all utility and structure work regardless of the type of work being performed.

20.01 RELATED WORK SPECIFIED ELSEWHERE

Chapter 1	Pavement Construction and Reconstruction
Chapter 2	Clearing and Grubbing
Chapter 10	Crushed Rock Surfacing
Chapter 11	Portland Cement Concrete
Chapter 21	Storm Sewers
Chapter 22	Sanitary Sewers
Chapter 23	Water Mains
Chapter 24	Signal and Street Lighting
Chapter 25	Ornamental Street Lighting
Chapter 30	Sodding and Seeding
Chapter 32	Soil erosion control

20.02 MATERIALS

The following materials are approved for use in the City of Lincoln pursuant to the 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.

20.02 MATERIALS (Continued)

C. CORRUGATED METAL TUNNEL LINER

Corrugated metal tunnel liner plate shall be copper steel galvanized and shall conform to the requirements of AASHTO "Standard Specification for Structural Plate for Pipe, Pipe-Arches and Arches", Designation M-167, and shall be of the diameter, length and gauge shown on the Plans.

D. KILN DRIED SAND

Kiln dried sand shall be of the same gradation as plaster sand as provided in Chapter 11 of these Specifications. The sand shall be dried thoroughly so the sand will flow freely into any voids within the confines of the bore hole or casing.

E. BEDDING AND FOUNDATION MATERIAL

Bedding material and 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). Bedding material shall be a well graded "crusher run" crushed rock or crushed concrete with a percent passing gradation range of 1"-100, 3/4"-90 to 100, #4- 40 to 60, and #200 - 0 to 10 unless otherwise designated on the plans or Special Provisions or directed by the Engineer. The requirement for soundness and durability of foundation and bedding material do not apply to this material.

F. GROUT

The grout shall be mixed in the volumetric proportions of two (2) parts portland cement, one (1) part fly ash, and not to exceed six (6) parts sand. Enough water shall be used to produce a pumpable grout.

G. FLOWABLE FILL
Flowable fill material shall meet the requirements of Chapter 11 of these specifications.

20.03 EARTHWORK

A. CLEARING AND GRUBBING

Clearing and grubbing shall be accomplished as provided in Chapter 2 of these Specifications.

B. TREE REMOVAL

The removal of trees and stumps shall be accomplished as provided in Chapter 2 of these 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 Specifications. The work shall be performed in accordance with Occupational Safety and Health requirements. Nothing contained in these 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. Access shall be provided at all times to fire hydrants and water valves in the vicinity of the work and fire fighting equipment shall have access to any structure at all times. Trenches shall not be opened more than 100 feet in advance of the installed utility or as directed by the Engineer. All trenches shall be backfilled as soon as practical after the pipe is in place, or as ordered by the Engineer. Unless otherwise specified or authorized by the Engineer, all excavated material shall be placed on the roadway side of the trench.

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 Engineer.

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 inches or greater in diameter shall be a minimum of 3 feet. In no case shall the excavation be less than 2 feet 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.

20.03 EARTHWORK (Continued)

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 inch 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 Engineer, 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 inches 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 Engineer, compaction of backfill within 3 feet of all structures and utility appurtenances, including but not limited to, valves, hydrants, manholes, and inlets, shall be accomplished by hand methods using the appropriate equipment for the soil type(s) encountered.

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 accordance with Section 20.06 of these Specifications. The initial 12 inches of backfill above the top of the pipe shall be carefully placed to protect the pipe bedding from further backfilling operations.

Backfill shall be compacted to a minimum density of ninety-five percent (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 two percent (2%) below and four percent (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.

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 Engineer, additional water shall be mixed in with backfill materials to allow compaction to be completed. Such water quantities shall be paid as a fixed cost "**EXTRA WORK**" item at the current price indicated on LSP #185. Lincoln Water System hydrant meter readings immediately before/after the addition of water shall establish the volume of water used.

E. 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 Engineer may order the sheeting be left in place if, in the Engineer'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 Engineer 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.

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.

F. 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 Engineer 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.

20.03 EARTHWORK (Continued)

F. DISPOSAL OF SURPLUS MATERIAL (Continued)

All material deemed unsuitable by the Engineer 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.

G. SOIL EROSION CONTROL

Soil Erosion Control shall be accomplished as provided in Chapter 32 of these Specifications.

20.04 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 Engineer, 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 Specifications. When crossing existing utilities or other structures, alignment and grade may be adjusted by the Engineer to provide clearance as required or deemed necessary to maintain minimum clearance, or to prevent future damage or contamination of either utilities or structures.

20.05 GROUND WATER

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.

20.06 FOUNDATION AND BEDDING

Foundation and bedding materials shall consist of crushed stone meeting the requirements of Section 20.02 of these Specifications. Gradation of the crushed stone may vary at the discretion of the Engineer in accordance with the classification or condition of the soil upon which the foundation and/or bedding material is placed.

Foundation materials generally will be required where unstable soil conditions exist at the bottom of the trench. Size may be varied at the option of the Engineer, but in no case shall the maximum size exceed 4 inches.

After the pipe has been properly placed to grade and line on the bedding course, additional bedding material shall be placed and compacted as called for on the plans. In areas where sheet piling or trench box is required to maintain vertical trench walls, and/or where flexible pipe is to be installed the bedding material shall extend from the top of the foundation course to a minimum of 18 inches above the top of the pipe.

The bedding material shall be placed in 6 inch 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 Details for pipe bedding.

Foundation material depths and sizes may be changed or eliminated only with prior approval of the Engineer.

BASIS OF PAYMENT

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.

Foundation material when placed in conformance with these Specifications as directed by the Engineer shall not be measured, but shall be paid as a fixed cost "**EXTRA WORK**" item at the current price indicated on the Lincoln Standard Plans (LSP # 185). 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.

20.07 BORING THE UTILITY PIPE

A. BORING

Where shown on the plans, the excavation shall be made by means of bore holes. The bore holes shall generally be made using mechanical augers of either the wet or dry type. Any annular space between the casing or the carrier pipe and the bore hole in excess of 5/8 inch shall be filled with pressure grout or other suitable material as directed by the Engineer. The boring shall be accomplished in such a manner as to interfere as little as possible with the railroad, roadway, utility, tree or structure being bored.

20.07 BORING THE UTILITY PIPE (Continued)

B. CASING PIPE

Where shown on the plans, the casing pipe shall be installed in the bore hole by mechanically pushing the casing into the hole, either simultaneously with or after the boring operation. Steel casing shall be installed in a bore hole with a maximum clearance of 5/8 inch. Corrugated metal encasement shall have a maximum clearance of 2 inches.

Corrugated metal encasement shall be provided with 2 inches diameter grout plugs at a maximum spacing of 10 feet centers along the top centerline of the encasement. After installation, the entire length of encasement shall be pressure grouted using a mixture of two (2) parts Portland cement, one (1) part fly ash, six (6) parts sand, and water.

The carrier pipe shall be installed, jointed, and shored inside the encasement in such a manner as to maintain grade and alignment so there will be no damage to the encasement coating or to the carrier pipe. The carrier pipe shall be supported and braced within the encasement pipe by using factory manufactured casing chocks. The number of chocks and spacing shall be per pipe manufactures recommendation for specific pipe size. Other proposed methods of installation shall be approved by the Engineer prior to construction.

BASIS OF PAYMENT

1. Boring for carrier pipes completed in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per linear foot for BORING FOR_____PIPE, 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 bore hole and for filling the resulting annular space around the carrier pipe when required in the Contract Documents. Carrier pipe of the various sizes and materials required to be placed in the bore hole shall be paid for as provided in the appropriate technical chapters.

2. Casing pipe bored in place in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per linear foot for _____ CASING, BORED IN PLACE, for each size and gauge called for in the Contract Documents. Such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to produce the bore hole, and install the casing pipe. Carrier pipes placed in casing pipes shall be paid for separately according to the various Chapters of these Specifications associated with the type of utility being constructed.

20.08 JACKING

Where shown on the plans the pipe shall be installed by jacking into place. The maximum allowable force on the pipe shall be per manufacture's recommendation. The material to be excavated shall not be removed more than 3 feet ahead of the leading edge of the pipe being jacked. Extreme care shall be taken to be sure that pipe is on line and grade as the jacking progresses. Any annular voids in excess of 5/8 inch shall be filled by pressure grouting.

20.08 JACKING (Continued)

BASIS OF PAYMENT

Utility pipe jacked in place in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per linear foot for _____ PIPE, JACKED IN PLACE, for each size and gauge called for in the Contract Documents. Such payment shall be full compensation for all materials, equipment, tools, labor and incidentals necessary to install the carrier pipe on line and grade, complete, including any temporary jacking blocks, sheeting, shoring, pressure grouting equipment and grout. The maximum length of jacking which shall be considered for payment is the plan quantity unless specifically authorized by the Engineer.

20.09 TUNNELING

Where shown on the plans the excavation shall be made by means of tunneling. Care shall be taken during installation to maintain alignment and grade and the shape of the tunnel. Adequate lighting and ventilation shall be maintained to provide a safe environment for the workers. Unless otherwise provided in the Contract Documents, the tunnel shall not be excavated more than 12 inches beyond the length of the segments of lines to be installed.

A. TUNNEL LINER PLATE

Adequate means shall be provided to keep the work free from water.

Steel tunnel liner plates shall be designed so that erection and assembly can be accomplished entirely from inside the tunnel. Liner plates shall be capable of withstanding the ring thrust load and transmitting this from plate to plate. The clear inside diameter of tunnel liners shall be within 4 inches of the nominal diameter indicated on the drawings.

Longitudinal joints in adjacent rings shall be staggered and not in alignment more often than every second ring.

Sufficient sections shall be provided with 1 5/8 inch or larger grouting holes, located near the centers, so that when the plates are installed there will be one line of holes on each side of the tunnel and one at the crown. The lower line of holes on each side shall not be more than 20 inches above the invert. The holes in each line shall not be more than ten feet apart and shall be staggered. All space between the lining and the earth shall be filled with grout forced in under pressure. The grout shall be mixed in the volumetric proportions of two (2) parts portland cement, one (1) part fly ash, and not to exceed six (6) parts sand. Enough water shall be used to produce a pumpable grout. As the pumping through any hole is stopped, it shall be plugged to prevent backflow of grout. Grouting shall be performed in a sequence which will preclude deflections exceeding five percent (5%) of the tunnel diameter.

20.09 TUNNELING (Continued)

B. STABILIZED SAND BACKFILL

After installation of the pipe in the tunnel, the entire annular space between the pipe and the tunnel walls shall be filled with stabilized sand. Stabilized sand shall be mixed in the proportions of at least three (3) sacks of portland cement for each cubic yard of sand. Stabilized sand shall be thoroughly mixed in a mechanical mixer and shall contain only enough water to produce an easily handled mixture. Stabilized sand shall be pumped into the casing so that all space is filled.

C. PAVED INVERT

The bottom portion of each casing constructed using tunnel liner plates shall be provided with a paved invert.

D. PLUGGING OF TUNNEL LINER

The annular space between the carrier pipe and the tunnel liner shall be plugged at each end of the tunnel liner using a water tight material.

BASIS OF PAYMENT

Tunneling and liners constructed in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per linear foot for ____" TUNNEL LINER PLATE, ___ GAUGE, INSTALLED, COMPLETE, for each size and gauge called for in the Contract Documents. Such payment shall be full compensation for all excavation, tunnel liner plates, grouting, other materials, equipment, tools, labor and incidentals necessary to install the tunnel liner.

20.10 DIRECTIONAL DRILLING

Where shown on the plans, the excavation shall be made by means of directional drilling. Directional drilling shall generally be made by drilling a small pilot hole along the designated path, enlarging of the pilot hole and pulling the pipe into place. Directional drilling is accomplished by utilizing specialized horizontal drilling rig with ancillary tools and equipment.

The Directional Drilling shall be accomplished in such a manner as to interfere as little as possible with the railroad, roadway, utility, tree or structure being directional drilled.

The contractor shall submit a tabulation of the pilot hole survey requirements, and the plan/profile drawings of the documented as-built location.

20.10 DIRECTIONAL DRILLING (Continued)

BASIS OF PAYMENT

Directional Drilling for carrier pipes completed in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per linear foot for DIRECTIONAL DRILLING FOR_____PIPE, 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 when required in the Contract Documents.

20.11 PAVEMENT CONSTRUCTION AND RECONSTRUCTION

Pavement reconstruction and miscellaneous masonry reconstruction shall be accomplished in conformance with Chapter 1 of these Specifications.

20.12 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 Engineer.

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 relaid shall be measured and paid for as provided in Section 21.04 of these Specifications. Crushed rock or gravel surfacing shall be measured and paid for as provided in Chapter 10 of these 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 Specifications.

20.13 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 two (2) intersections may be closed at one time within project limits, even though the third intersection may not violate the 650 foot 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 Engineer as a disruption of normal ingress and egress to the public right- of-way within project limits.

4. Temporary restoration will be required to reduce long-term disruptions and inconvenience during construction. Two (2) weeks after beginning work in an area, the Engineer 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. Crushed rock, properly maintained, will be acceptable for temporary restoration of sidewalks and driveways, whereas temporary concrete of 4 inches minimum thickness will be required for pavement restoration.

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 Engineer and shall include the beginning date and duration. If work is to be resumed prior to expiration of time requested, forty-eight (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.

B. SUSPENSION OF WORK (Continued)

The Engineer 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 Engineer shall notify the Contractor, in writing, of the new completion date of the Contract as provided above.

20.14 SUBSTANTIAL COMPLETION

Refer to Chapters 21 through 23 for a specific definition of Substantial Completion for each type of utility work.

20.15 FINAL ACCEPTANCE

Refer to Chapters 21 through 23 for a specific definition of Final Acceptance for each type of utility work.

20.16 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

Chapter 21

STORM SEWERS

ARTICLE	TITLE
21.00	General
21.01	Related Items Specified Elsewhere
21.02	Materials
	A. Concrete B. Reinforced Concrete Pipe C. Rubber Gasket D. Iron Castings E. Concrete Reinforcement F. Brick G. Mortar H. Precast Manhole Sections I. Precast Box Culverts J. Wire Gabion K. Gabion Stone L. Grout Filled Fabric M. Geotextile Filter Fabric N. Polyethylene Pipe
21.03	Excavation and Backfill
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A. Storm Sewer Manholes
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21.09 Gabion Installation

A. General
B. Construction Details
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21.10 Grout Filled Fabric Channel Liner Installation

A. General
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C. Basis of Payment

21.11 Geotextile Filter Fabric Installation

A. General
B. Construction
C. Basis of Payment

21.12 Substantial Completion

21.13 Final Acceptance

21.14 Guarantee

CHAPTER 21

STORM SEWERS

21.00 GENERAL

The work covered in this Chapter shall include the laying and jointing of storm sewer pipe, concrete box construction, concrete channel liners, and construction of storm sewer appurtenances.

21.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 9	Chain Link Fencing & Pipe Rail Fencing
Chapter 11	Portland Cement Concrete
Chapter 20	Construction for Utilities and Structures

21.02 MATERIALS

A. CONCRETE

Concrete used in storm sewer construction and reconstruction shall conform to the requirements of Chapter 11 of these Specifications for L-3500 Concrete.

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 accordance 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 accordance with the requirements of “Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe”, ASTM Designation C 507.

3. When so indicated on the plans, reinforced concrete D-load pipe shall be supplied and shall be manufactured in accordance with the requirements of “Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe”, ASTM Designation C 655.

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 seventy (70) hours at a forty degrees Celsius (40° C) at 100 PHM, bent loop with no cracks.

21.02 MATERIALS (Continued)

C. RUBBER GASKET (Continued)

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 accordance with the manufacturer's recommendations.

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. WELDED STEEL FABRIC: Welded steel fabric shall consist of sheets or strips manufactured for this purpose. The steel wire shall comply with "Standard Specification for Steel Wire, Plain for Concrete Reinforcement", ASTM Designation A 82. Intersecting members shall be rigidly welded at right angles in such a manner as to develop the full tensile strength across the weld.

   Steel fabric is specified on the plans by gauge and spacing of wires. The gauge number specified shall be in accordance with ASTM Wire Gauge Standard as given in the above reference.

3. 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 sewer 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.

21.02 MATERIALS (Continued)

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:

Alternate	Portland Cement	Masonry Cement	Hydrated Lime or Lime Putty	Aggregate Loose & Damp
1	½	1	0	Not less than 2¼ nor more than 3 times the sum of the volume of the cements and lime used
2	1	0	1/4-1/2	

H. PRECAST MANHOLE SECTIONS

Precast manhole sections shall be manufactured in accordance with the requirements of "Standard Specification for Precast Reinforced Concrete Manhole Sections", ASTM Designation C 478.

I. PRECAST BOX CULVERTS

When so indicated on the plans, precast box culverts shall be supplied and shall be manufactured in accordance 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 feet. 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 ± 5 percent 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 3¼ inches by 4½ inches. The wire mesh shall be made of galvanized steel wire having a diameter of 0.1181 inches ± 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 accordance 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.

21.02 MATERIALS (Continued)

J. WIRE GABION (Continued)

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 specifications as the wire used in the mesh, except that it shall have a diameter of 0.0866 inches $\pm$ 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 specifications for galvanized baskets except that the mesh wire exclusive of PVC coating may be 0.0118 inches 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:

1. Immersion of the wire for twenty (20) hours in Hydrochloric acid (solution composed fifty percent (50%) H_2O and fifty percent (50%) HCL concentration 21 Baume-Test temperature fifteen degrees Celsius (15ºC) or immersion for sixty (60) hours in a saturated solution of salt water at fifteen degrees (15ºC) 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 thee and one-half (3.5%) solution of Potassium Permanganate ($KMnO_4$) for a continuous period of fifty hours (50) at an ambient temperature, the maximum penetration between the coating and the core wire from a square cut end shall be 0.472 inches .

3. The protective coating shall not be altered or deformed by temperatures ranging between 150.0ºF and -40ºF.

K. GABION STONE

The stone used to fill the gabion shall be from sources approved by the Engineer. The size of the stone shall be such that not more than five percent (5%) by mass shall pass the 4-inch sieve. The maximum weight for any one stone shall not exceed 50 pounds. The maximum length of stone shall not exceed 12-inches. Each stone shall have one dimension that has a measurement of 4-inches. 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 Specifications may be used at the option of the Contractor. The mix shall exhibit a compressive strength of 2000 p.s.i. at twenty-eight (28) days when made and tested in accordance 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.

21.02 MATERIALS (Continued)

L. GROUT FILLED FABRIC (Continued)

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.

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 twenty percent (20%) higher at seven days than that of companion test cylinders made in accordance 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 twenty-eight (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, one thousand (1000) denier nylon or one thousand (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 Engineer. 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 five inch or eight inch or 10 inch 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 inch 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 insure that no damage to filter cloth occurs.

21.02 MATERIALS (Continued)

L. GROUT FILLED FABRIC (Continued)

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 Engineer, the Contractor shall demonstrate the suitability of fabric design by injecting the proposed grout into six inch 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 ten (10) minutes. The sleeves shall be constructed of the same fabric used in the individual layers of fabric. Six inch by twelve inch test cylinders shall be cut from each specimen and tested in accordance with "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens", ASTM Designation C 39.

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:

Physical Property	Test Procedure	Minimum Test Results
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 Taber Test (1000 revolutions, 1 kg. load/wheel)	55 (min.)
Pore Size - EOS	Corps of Engineers CW-02215	70-100
Ultraviolet Resistance % Strength Retention	ASTM D-1682 (After 500 Xenon Weatherometer Hours)	70

*Tension testing machine with ring clamp; steel ball replaced with a 5/16 inch 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 MATERIALS (Continued)

N. POLYETHYLENE PIPE

When approved by the Public Works Director for use in the public right-of-way, shall be a high-density polyethylene corrugated pipe with an integrally formed smooth interior. Polyethylene pipe and fittings shall be made of polyethylene compounds meeting or exceeding the requirements of Corrugated Polyethylene Pipe 12" to 48" Diameter. All polyethylene pipe shall be affixed with a Plastic Pipe Institute 3rd Party Certification label as validation that the pipe meets or exceeds the material properties set forth in Corrugated Polyethylene Pipe 12" to 48" Diameter. Polyethylene pipe shall not exceed 36 inches in diameter and must have a minimum of 2 feet of backfill between the crown of the pipe and the sub-grade elevation for all surfaces that are to be paved. All backfill and bedding shall conform to the Lincoln Standard Plans and must be placed/compacted in layers not exceeding 8 inches loose lift thickness and brought up evenly and simultaneously on both sides of the pipe to an elevation of at least 2 feet above the crown (Note: bedding material must be hand placed). Pipe sections shall be joined with integral bell and spigot couplers having a rubber o-ring gasket meeting the requirements of Standard Specification for Elastormetric Seals (Gaskets) for Joining Plastic Pipe (ASTM F477). Fittings shall be firmly secured with split couplings, corrugated to engage the pipe corrugations and shall engage a minimum of four corrugations, two on each side for the pipe joint. A neoprene gasket must be utilized with the coupling to provide a soil tight fitting. Whenever polyethylene pipe crosses any rigid structure or is connected to a rigid structure, flowable fill (controlled low strength mortar {CLSM} meeting the design approved by the City Engineer) shall be used in the trench in lieu of the rock bedding for a minimum of 5 feet along the longitudinal dimension of the polyethylene pipe and to a minimum of 1 foot above the crown of the pipe (Note: care should be taken to avoid ‘floating’ the pipe off grade when installing with flowable fill). All polyethylene pipe shall be mandrel tested, ten (10) days after the backfill is completed and any location which has a deflection exceeding 5%, shall be corrected and backfilled with CLSM to the same dimensions of those required for rigid structures.

21.03 EXCAVATION AND BACKFILL

Excavation and backfill shall conform to the requirements of Chapter 20 of these Specifications.

21.04 LAYING PIPE

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 sewer 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 one (1) part Portland Cement and two (2) parts of clean sand by volume. If the pipes are of 36 inches 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 Engineer.

21.04 LAYING PIPE (Continued)

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 Engineer.

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 sewer 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 Engineer, 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 sewer 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 Engineer, 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 sewer pipes, the Contractor shall remove and dispose of the pipes off the job site.

BASIS OF PAYMENT

Reinforced concrete storm sewer pipe, elliptical pipe, D-load pipe, and precast reinforced concrete box storm sewers, constructed in conformance with these Specifications and accepted by the Engineer, 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 ___ INCHES REINFORCED CONCRETE PIPE STORM SEWER, CLASS ___; ___INCHES X ___INCHES ELLIPTICAL REINFORCED CONCRETE PIPE STORM SEWER, CLASS __; ___INCHES REINFORCED CONCRETE PIPE STORM SEWER, D-LOAD = ___; or ___FEET X ___FEET PRECAST REINFORCED CONCRETE BOX STORM SEWER, 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.

Reinforced concrete storm sewer pipe removed and relaid, removed and salvaged, or removed in accordance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per linear foot for REMOVE AND SALVAGE ___INCHES REINFORCED CONCRETE STORM SEWER PIPE, REMOVE AND RELAY ___INCHES REINFORCED CONCRETE STORM SEWER PIPE, or REMOVE ___INCHES STORM SEWER PIPE. 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.

Grading required as a part of storm sewer 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.

21.05 CURVED REINFORCED CONCRETE PIPE STORM SEWER

Straight sections of reinforced concrete pipe may be installed on curves by opening the outside of the joints in accordance with this Specification. Where reinforced concrete pipe is to be installed on radii smaller than those shown in this Specification, radius or beveled pipe shall be used only with the prior approval of the Engineer.

21.05 CURVED REINFORCED CONCRETE PIPE STORM SEWER (Continued)

Reinforced concrete pipe with mortar of mastic-packed joints shall have a maximum joint opening of not more than three-fourths (3/4) 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 sewer pipes as provided in Section 21.04 of these Specifications.

TABLE 21.05 CURVED REINFORCED CONCRETE STORM SEWER 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	6 ft. LL	7.5 ft LL	8 ft. LL
15	2	1 ½	52	78	98	-----
18	2 1/4	1 3/4	53	79	99	-----
21	3 ½	2 5/8	41	61	76	-----
24	2 3/4	2 1/16	59	88	110	-----
30	3 ½	2 5/8	57	85	-----	108
36	3 ½	2 5/8	67	101	-----	129
42	4	3	68	102	-----	130
48	4 ½	3 3/16	73	110	-----	140
54	5	3 3/4	70	104	-----	131
60	5	3 3/4	77	115	-----	146
66	5	3 3/4	85	127	-----	161
72	5	3 3/4	92	138	170	174
78	5	3 3/4	100	149	184	188
84	4 ½	3 3/8	119	178	222	227

21.06 CONNECTIONS TO EXISTING STORM SEWERS

The Contractor shall make all connections and taps of the new storm sewers to existing storm sewer systems as shown on the plans. Existing manhole or inlet bottoms shall, if necessary, be reconstructed in substantially the same manner as herein specified.

BASIS OF PAYMENT

Connections to existing storm sewer systems, constructed in accordance with these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per each for TAP EXISTING STORM SEWER MANHOLE AND RESHAPE INVERT; TAP EXISTING STORM SEWER INLET AND RESHAPE INVERT; TAP EXISTING REINFORCED CONCRETE PIPE; or TAP EXISTING REINFORCED CONCRETE 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 sewers in accordance 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.

21.07 REINFORCED CONCRETE BOX STORM SEWERS AND STRUCTURES

A. GENERAL

Reinforced concrete box storm sewers 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 two inches 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 Engineer or observer 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.

B. FORMS (Continued)

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 twelve to twenty-four (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 seven (7) days when the average ambient temperature has been 55° F for twelve (12) hours or more. Roof forms shall not be removed without permission of the Engineer.

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 six (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 Engineer. Splices in adjacent bars shall be staggered.

Unless otherwise shown in the plans, bars shall be spliced by lapping the ends. Laps shall be thirty-six (36) bar diameters for Grade 60, and twenty-four (24) bar diameters for Grade 40 (300). Lapped splices shall be made by securely wiring the bars in contact, maintaining alignment, and clearance.

BASIS OF PAYMENT

When called for in the proposal, payment for reinforcing steel for reinforced concrete box storm sewers and structures placed in conformance with these Specifications and accepted by the Engineer shall be made at the contract unit price bid per pound for REINFORCING STEEL FOR BOX STORM SEWER, 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 accordance with the plans.

When the plans or Special Provisions provide for unit price bids per linear foot or lump sum complete for box storm sewers 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 Section 21.07 D.

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 inches 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 one (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 seven (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 one inch or as otherwise directed by the Engineer. 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.

D. CONCRETE (Continued)

5. Backfill Around and Over Concrete Box

Backfill along and over the reinforced concrete box or structure sewer 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:

MINIMUM AVERAGE AMBIENT TEMPERATURE	TIME
45° F	17 Days
55° F	8 Days
73° F	5 Days

BASIS OF PAYMENT

When called for in the proposal, concrete for box storm sewers or structures placed in conformance to these Specifications and accepted by the Engineer shall be paid for at the contract unit price bid per cubic yard for CONCRETE FOR BOX STORM SEWER, 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 sewers constructed in conformance with these Specifications and accepted by the Engineer shall be paid for at the contract unit price bid per linear foot for ___ X ___ REINFORCED CONCRETE BOX STORM SEWER, 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.

When called for in the proposal, reinforced concrete structures constructed in conformance with these Specifications and accepted by the Engineer 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 Engineer.

21.08 APPURTENANCES AND MISCELLANEOUS WORK

A. STORM SEWER MANHOLES

1. Brick Manholes

Brick manholes shall be built where and as indicated on the plans. Their form and dimensions shall be in accordance with the drawings included with these Specifications. The brick in each course shall break course with those in the adjoining courses. Mortar shall be mixed in the proportions of one (1) part of Portland or mortar cement and two (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 one-half inch.

2. Reinforced Concrete Manholes

Reinforced concrete manholes shall be built in accordance with Section 21.07, "Reinforced Concrete Box Storm Sewers and Structures".

3. 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.

BASIS OF PAYMENT

Storm sewer manholes constructed in conformance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid per each for STORM SEWER MANHOLE, ___INCHES, COMPLETE, for the various sizes required. Size of the manhole shall be identified as the largest nominal size of its intersecting storm sewers. 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.

B. STORM SEWER INLETS

1. Brick Inlets

Storm sewer inlets shall be constructed where and as indicated on the plans. Walls shall be of brick masonry laid as above specified for manholes. The inside and outside of the walls shall be plastered with mortar one-half inch 13 mm) thick.

Each inlet bottom shall be fully formed so as to make the curves of the tributary sewers, and all corners shall be filled with concrete as directed by the Engineer or observer. All inlet rings, covers, grates, and the forms and dimensions of all inlets shall comply with the City of Lincoln Standard Plans.

2. Reinforced Concrete Inlets

Reinforced concrete inlets shall be built as provided above and in accordance with Section 21.07, "Reinforced Concrete Box Storm Sewers and Structures". The concrete inlet tops shall be set to grade and sealed with mortar. The ring and cover shall be adjusted to grade with brick and mortar and shall be sealed inside and out with mortar.

B. STORM SEWER INLETS (Continued)

BASIS OF PAYMENT

Storm sewer inlets constructed in conformance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid per each for ___INCHES STORM SEWER INLET, COMPLETE; ___INCHES STORM SEWER INLET USING SALVAGED TOP, COMPLETE; ___INCHES CANTED STORM SEWER INLET, COMPLETE; ___INCHES RADIUS STORM SEWER INLET, COMPLETE; or GRATE INLET, TYPE ___, COMPLETE, for the various sizes and types required. Such payment shall be full compensation for all excavation, brick, mortar, concrete, inlet top, castings, curb as called for on the Standard Plans, backfill, materials, equipment, tools, labor, and incidentals necessary to complete each inlet.

C. OPEN DITCHES

Open ditches shall be constructed in accordance with the lines and grades indicated on the plans and/or as directed by the Engineer.

BASIS OF PAYMENT

Open ditches constructed in conformance with these Specifications and accepted by the Engineer 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 Engineer, 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.

D. CONCRETE DITCH LINERS

Concrete liners for open ditches shall be built to lines, grades, and sections as shown on the plans.

BASIS OF PAYMENT

Concrete ditch and channel liners constructed in conformance with these Specifications and accepted by the Engineer shall be measured and paid for at the contract unit price bid per linear foot for ___ REINFORCED CONCRETE LOW FLOW LINER, or ___ REINFORCED CONCRETE CHANNEL 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.

E. CONVERTING APPURTENANT STRUCTURES

When called for on the plans, existing manholes shall be converted to inlets by removing the manhole top, castings and walls, replacing any brick which is damaged, placing the new inlet top to the proper elevation, and reforming the inlet throat and adjacent curbs as directed by the Engineer.

E. CONVERTING APPURTENANT STRUCTURES (Continued)

When called for on the plans, existing inlets shall be converted to man holes 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 Engineer.

BASIS OF PAYMENT

Manholes converted to inlets and inlets converted to manholes in accordance with these Specifications and accepted by the Engineer shall be counted and paid for at the contract unit price bid per each for CONVERT MANHOLE TO INLET, COMPLETE, or CONVERT INLET TO MANHOLE, COMPLETE. No classification shall be made as to size for either pay item. 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.

F. REINFORCED CONCRETE ELBOWS AND COLLARS

When called for on the plans, the Contractor shall construct reinforced concrete collars or elbows at the locations indicated. The collars and elbows shall conform to the details shown on the drawings.

Measurement and payment for reinforced concrete collars and elbows shall conform to Section 21.07 of these Specifications.

G. REINFORCED CONCRETE FLARED END SECTIONS

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 Engineer.

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.

BASIS OF PAYMENT

Flared end sections and flared end sections with grates, placed in conformance with these Specifications and accepted by the Engineer, shall be counted and paid for at the contract unit

G. REINFORCED CONCRETE FLARED END SECTIONS (Continued)

price bid per each for ___ REINFORCED CONCRETE FLARED END SECTION and ___ REINFORCED CONCRETE FLARED END SECTION WITH GRATE, for the various sizes called for in the proposal.

Flared end sections to be removed and salvaged, removed and reset, or removed, in accordance with these Specifications and accepted by the Engineer, shall be counted and paid for at the contract unit price bid per each for REMOVE AND SALVAGE ___ REINFORCED CONCRETE FLARED END SECTION; REMOVE AND RESET ___ REINFORCED CONCRETE FLARED END SECTION; or REMOVE ___ REINFORCED CONCRETE FLARED END SECTION. 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.

H. REMOVAL OF EXISTING STRUCTURES

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.

BASIS OF PAYMENT

The removal of existing appurtenant structures as called for on the plans, completed in conformance with these Specifications and accepted by the Engineer, 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 INLET, SALVAGE TOP, COMPLETE; REMOVE EXISTING JUNCTION BOX, COMPLETE; REMOVE EXISTING GRATE INLET, COMPLETE; or REMOVE EXISTING HEADWALL, COMPLETE. 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.

I. RIP-RAP

Concrete or stone rip-rap shall be placed on prepared slopes and channel bottoms at locations shown on the plans. The materials used shall be hard stone, broken concrete, 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 generally conform to the requirements of the plans or Special Provisions. Soundness specifications shall not apply to concrete rip-rap.

Geotextile conforming to the requirements of Chapter 32 of these Specifications shall be placed on the prepared slopes prior to placement of the rip-rap. Placement of the geotextile shall be considered subsidiary to the placement of the rip-rap.

Concrete or other masonry produced as a result of removal of such items at the job site may be used only with prior approval of the Engineer.

21.08 APPURTENANCES AND MISCELLANEOUS WORK (Continued)

I. RIP-RAP (Continued)

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.

BASIS OF PAYMENT

Rip-rap placed in conformance with these Specifications and accepted by the Engineer shall be measured by weighing the truck. Tare weight shall be the basis of payment. Payment shall be made at the contract unit price bid per ton for RIP-RAP, IN PLACE. 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.

21.09 GABION INSTALLATION

A. GENERAL

The Contractor shall furnish, assemble, tie, and fill gabion constructed in accordance with these Specifications and placed in conformity with the lines, grades, and dimensions shown on the plans or as directed by the Engineer. The location for installation of each type of gabion is indicated on the plans.

B. CONSTRUCTION DETAILS

1. Assembly

Each gabion unit shall be assembled by binding together all vertical edges with wire ties on approximately six inch (6") spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every four inches (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 Engineer. 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 two inches 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.

21.09 GABION INSTALLATION (Continued)

C. BASIS OF PAYMENT

The Contractor shall be paid for the actual number of baskets placed and filled at the contract bid price for "TYPE ___, WIRE GABION, IN PLACE" or "TYPE ___, WIRE GABION, PVC COATED, 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 accordance with these Specifications and as shown on the Plans.

21.10 GROUT-FILLED FABRIC CHANNEL LINER INSTALLATION

A. GENERAL

The work covered by these Specifications consists of furnishing all labor, materials, and equipment for installing grout-filled fabrics.

B. CONSTRUCTION DETAILS

The installation of grout-filled fabric erosion control mats shall be performed in accordance with provisions of these Specifications. The Contractor shall furnish records of past successful experience in performing this type of work and shall submit to the Engineer for approval a description of the materials to be used in the proposed method of operations, and shall furnish records and data to demonstrate that the finished mats will meet, in all respects, the quality and properties required by these Specifications. The Contractor shall save the City harmless from liability of any kind arising from the use of any patented or unpatented invention in the performance of this work.

1. Preparation of Surfaces

The slopes or surfaces to be protected shall be prepared and graded to such an extent that they are normally stable in the absence of erosive forces. The placement of fill material required to restore the slopes to acceptable and stable conditions shall be approved by the Engineer. A fabric envelope in a mat configuration shall be positioned over these surfaces and filled with a pumpable sand/cement grout in such a way as to form a stable mat of suitable weight and configuration.

2. Mixing and Pumping of Grout

Only approved mixing and pumping equipment shall be used in preparing and handling of the grout. All oil or rust inhibitors shall be removed from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout before the mixers are used.

All materials shall be accurately measured by volume or weight as they are fed into the mixer. The quantity of water shall be such as to produce a grout having a pumpable consistency. Time of mixing shall be not less than one minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding two and one half hours (2 ½) in temperatures below 70° F and for a period not exceeding two hours at higher temperatures. If there is a lapse in a pumping operation, the grout shall be recirculated through the pump or through the mixer drum (or agitator) and pump.

21.10 GROUT-FILLED FABRIC CHANNEL LINER INSTALLATION (Continued)

B. CONSTRUCTION DETAILS (Continued)

3. Placement of Grout in Mat Fabric

Prior to grout injection, the fabric shall be positioned at its design location. Grout shall be introduced into the space between the layers of fabric and shall be injected in such a way that excessive pressure on the fabric envelope is avoided. Where convenient, adjacent fabric panels shall be joined before grout injection by field sewing the two layers of fabric separately, edge to edge. Where adjacent panels cannot be joined in this manner, or where called for by plans, adjacent panels shall be lapped a minimum of two feet . In no case shall simple butt joints be permitted.

Holes in the fabric left by the removal of the grout hose or inserts, shall be temporarily closed by inserting a piece of burlap or similar material. The burlap shall be removed when the mortar is no longer fluid and the surface is firm to hand pressure. Foot traffic on the filled revetment mats shall be limited to an absolute minimum for one hour after pumping in order to reduce indentation.

C. BASIS OF PAYMENT

Grout-filled fabric channel liner, constructed in accordance with the plans and these Specifications and accepted by the Engineer, shall be measured and paid for at the contract unit price bid per square foot for ___ GROUT FILLED FABRIC CHANNEL LINER, IN PLACE. Such payment shall be full compensation for all fabric forms, grout, filling the forms with grout, excavation, slope preparation, equipment, materials, tools, labor, and incidentals necessary to complete the work.

21.11 GEOTEXTILE FILTER FABRIC INSTALLATION

A. GENERAL

The work covered by these 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 inches. 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 inches.

21.11 GEOTEXTILE FILTER FABRIC INSTALLATION (Continued)

B. CONSTRUCTION (Continued)

2. Gabion/Embankment Stabilization (Continued)

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 accordance with the plans and these Specifications and accepted by the Engineer, 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.

21.12 SUBSTANTIAL COMPLETION

Storm sewer 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.

21.13 FINAL ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required work is complete and accepted by the Engineer, 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 Engineer.

21.14 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.

22.11 FINAL ACCEPTANCE

The project shall be considered eligible for final acceptance by the City when all required work is complete and accepted by the 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 Project Manager. Eligibility for final acceptance shall not be delayed for more than sixty (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.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 22

SANITARY SEWERS

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CHAPTER 22

SANITARY SEWERS

22.00 GENERAL

The work covered in this Chapter shall include the laying and jointing of sanitary sewers and the construction of their appurtenances.

22.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 11 Portland Cement Concrete
Chapter 20 Construction for Utilities and Structures

22.02 MATERIALS

The following pipe materials are approved for use in the City of Lincoln pursuant to the specifications described herein. Developers, consultants, and contractors may request consideration of alternate pipe materials to the Director of Public Works and Utilities.

APPROVED SANITARY SEWER PIPE MATERIALS
Vitrified Clay Sewer Pipe (VCP)
Centrifugally Cast Fiberglass Mortar Pipe (CCFMP)
Polyvinyl Chloride Sewer Pipe (PVC)
Reinforced Concrete Pipe with PVC Lining (RCP)
Cured-In-Place Pipe (CIPP)

A. VITRIFIED CLAY SEWER PIPE AND JOINTS

Vitrified clay sewer pipe shall be of the best quality of hard-burned, vitrified clay or shale pipe conforming to the requirements of "Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated" ASTM Designation C-700 for extra strength pipe. Clay pipe shall be joined with factory pre-molded joints. The joints shall conform to "Specification for Compression Joints for Vitrified Clay Pipe and Fittings" ASTM Designation C-425, except that the joint gasket must be secured to one of the other joining faces prior to socketing.

B. Centrifugally Cast Fiberglass Mortar Pipe (CCFMP)

1. Pipe and Fittings
Centrifugally Cast Fiberglass Mortar Pipe (CCFMP) shall be of high quality conforming to the requirements of ASTM D2412 "Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading", ASTM D3262 "Standard Specification for Reinforced Plastic Mortar Sewer Pipe", and ASTM D3681 " Method for Determining Chemical resistance of Reinforced Thermosetting Resin Pipe in Deflected Condition." The joints shall conform to ASTM D4161 "Specification for Fiberglass (Glass-Fiber-Reinforced) Thermosetting Resin Pipe Joints Using Flexible Elastomeric Seals".

22.02 MATERIALS (Continued)

C. POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPE

1. Pipe and Fittings

PVC pipe and fittings for 15 inch and smaller sizes shall meet the requirements of "Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings" ASTM D-3034, Type PSM, SDR 35 minimum. PVC pipe and fittings for 18 inch through 27 inch sizes shall meet the requirements of "Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings" ASTM F-679, minimum wall thickness T-1. PVC pipe and fittings manufactured under "Standard Specification for Type PS-46 and Type PS-115 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings" ASTM F-789, Type PS-46 or "Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings" ASTM F-679 with T-2 wall thickness shall <u>not</u> be acceptable. All pipe shall be furnished in standard laying lengths. Shorter field cut lengths for curvilinear alignment may be used, provided that spigot ends are carefully cut to a perpendicular cross section and the ends beveled to permit proper jointing.

2. Joints for Pipe and Fittings

Joints for PVC non-pressure pipe and fittings shall meet the requirements of Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals" ASTM D-3212 for integral bell, single synthetic rubber gasket push-on joints. Joints using separate couplings or couplings solvent welded to one end of the pipe shall not be acceptable. Lubricants, if required, shall have no deteriorating effects on the gasket and pipe materials.

3. Manhole Water Stops

Water stops shall be required for all connections of PVC pipe with manholes. Water stops shall be of a type approved by the Project Manager, consisting of specifically manufactured synthetic elastomeric rings or boots stretched around the pipe and clamped, if applicable, with stainless steel clamps.

4. Transition Joints

Joints between PVC and other pipe materials shall be made with special transition adaptor fittings or stainless steel clamped elastomeric couplings factory fabricated specifically for the use intended and approved by the Project Manager.

D. REINFORCED CONCRETE SEWER PIPE

1. Reinforced concrete sewer pipe, 18 inch or larger, shall conform to Standard Specification for Reinforced Concrete Culvert , Storm Drain, and Sewer Pipe ASTM Designation C-76 or Standard Specification for Concrete D-Load Culvert, Storm Drain, and Sewer Pipe" C-655, as specified on the plans or Special Provisions, except as herein provided.

The coarse aggregate used in the manufacture of the pipe shall conform to the requirements of Article 11.01. The concrete used in the manufacture of the pipe shall contain at least 6 sacks of cement per cubic yard of concrete. All pipe shall not be less than 7.5 feet in length, with the exception of fittings and closure pieces and on curvilinear alignment (see Section 22.05).

D. REINFORCED CONCRETE SEWER PIPE (Continued)

2. Joints and Gaskets

Reinforced concrete sewer pipe shall be circular in cross-section with a tongue and groove joint and shall be furnished with an "O" ring-type gasket. The joints shall be capable of passing the standard infiltration/exfiltration tests as prescribed in the Standard Specifications for sanitary sewers. The gaskets shall conform to “Standard Specification for Reinforced Concrete Low-Head Pressure Pipe”ASTM C-361, Section 6.9, except minimum tensile strength shall be 1500 p.s.i. hardness shall be 40±5, maximum water absorption shall not be greater than 10%, and the polymer shall be neoprene or other synthetic rubber. Natural rubber gaskets will not be accepted. Lifting holes will not be allowed.

3. Polyvinyl Chloride (PVC) Liner

RCP for sanitary sewer shall be lined with Polyvinyl Chloride (PVC) sheet liners covering two hundred seventy degrees (270º) of the interior surface of the pipe. Liner shall be T-lock as manufactured by Ameron Protective Linings Division, Brea, California or prior approved equal.

Tensile specimens shall be prepared and tested in accordance with “Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension ASTM Designation D 412 using die B. Weight change specimens shall be 1 inch by 3 inch samples of the sheet thickness. Specimens may be taken from sheet and strip at any time prior to final acceptance of the work.

All PVC plastic liner plate sheets, joint, corner, and welding strips shall have the following physical properties when tested at 77o F +/- 10o F.

Property	**Initial**	**After Conditioning**
Tensile Strength, psi	22,000 min.	21,000 min.
Elongation at Break	200% min.	200% min.
Shore durometer, Type D	1-sec. 50-60 10-sec. 35-50	+/- 5 after 112 day @25º C +/- 3º +/- 5 initial test result
Weight Change		+/- 1.5%

Chemical Solution	Concentration
Sulfric Acid	20%
Sodium hydroxide	5%
Ammonium hydroxide	5%
Nitric Acid	1%
Ferric chloride	1%
Soap	0.1%
Detergent (linear aklyl benzyl sulfonate or LAS)	0.1%
Bacteriological	BOD not less than 700 ppm

D. REINFORCED CONCRETE SEWER PIPE (Continued)

Liner sheets shall be a minimum of 0.065 inch in thickness. Locking extension (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2 ½ inches apart and shall be at lest 3/8 inch high.

All pipe shall have a two hundred seventy degree (270°) liner coverage with the longitudinal edges of the sheet butt welded. When pipe tubes are furnished, these shall be shop-welded joints. Installation of the liner, including preheating of sheets in cold weather and the welding of all joints, shall be accomplished in accordance with the manufacture's recommendations. Pipe with damaged lining which has been repaired shall be accepted only upon approval of the Project Manager.

E. PRESSURE PIPE MATERIALS

Where pressure pipe materials are required for special sanitary sewer construction, such as in cases involving minimum clearance between water mains and sanitary sewer mains, the Contractor shall use polyvinyl chloride pressure pipe as specified below. Ductile iron pipe shall only be used where specifically designated on the plans or as directed by the Project Manager to meet severe structural loading conditions.

1. Polyvinyl Chloride (PVC) Pressure Pipe

PVC pressure pipe shall be cast iron pipe size O.D., meeting the requirements of the latest revision of AWWA C900 for DR 18 (pressure rating 150 p.s.i.) pipe. Pipe shall be furnished in 20 foot standard lengths with beveled male ends and a painted ring for checking the seating depth. Joints shall be push-on type, integral bell with single synthetic elastomer gaskets.

2. Ductile Iron Pipe (DIP)

Ductile iron pipe, joints, and polyethylene encasement shall meet the applicable requirements of the same under Chapter 23 of these Specifications. All DIP shall be Class 52 minimum unless otherwise indicated on the plans.

3. Transition Joints

Joints between PVC pressure pipe or DIP and other sanitary sewer pipe materials shall be made with special transition adaptor fittings or stainless steel clamped elastomeric couplings, factory fabricated specifically for the use intended and approved by the Project Manager.

F. CURED-IN-PLACE PIPE (CIPP)

Cured-in-place pipe liners shall be fabricated from a polyester fiber belt lined on one side with polyurethane and impregnated with a liquid thermosetting resin and catalyst. The materials used shall provide a cured liner that shall be chemically resistant to municipal wastewater flows both acidic and alkaline. The tube material shall meet the requirements of "Standard Specification for Practice for Sampling for Surface Particulate Contamination by Tape Lift" ASTM Designation F 1216, Section 5.1. The resin system shall meet the requirement of "Standard Specification for Practice for Sampling for Surface Particulate Contamination by Tape Lift" ASTM Designation F 1216. The chemical resistance requirements shall conform to ASTM Designation F 1216, Appendix 2.

BASIS OF DESIGN

When submitting the Proposal and prior to opening of the bids, the Contractors shall satisfy themselves as to the proper design of the wall thickness of the liner. The contractors shall submit with their bid the design calculations for deriving the thickness(es) of the liner for each portion of the entire project. The basis of this design shall be the internal TV inspection tape provided by the City with the bidding documents. Unless otherwise approved by the City, the Contractor shall design the CIPP for a fully deteriorated condition, with no strength assigned to the existing pipe. The thickness design of the CIPP shall conform to "Standard Specification for Practice for Sampling for Surface Particulate Contamination by Tape Lift" ASTM Designation F 1216. The award of the Contract will not be made until the City has approved the Contractor's design calculation and verified total costs for the submittal. The CIPP diameter, length and wall thickness shall be appropriate for the entire reach of the project. The Contractor shall verify the actual sewer lengths and wall thickness prior to beginning work.

G. OTHER SEWER PIPE

Other sewer pipe material may be authorized only by special permission.

H. MANHOLES AND APPURTENANCES

1. Concrete

Concrete used in the construction of manholes, concrete collars, and other incidental work shall conform to the requirements of Chapter 11 of these Specifications for L3500 Concrete.

2. Brick

All brick shall be clean, hard-burned cored type brick having true shape and sharp edges for their whole length. Unless otherwise specified, all brick shall be new. Bats shall be used only to close joints, and no bats smaller than a half brick shall be used. The brick shall meet all the requirements of "Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)" ASTM Designation C-216, Type FBA, Grade SW.

3. Iron Castings

Manhole covers and frames and manhole steps shall be iron castings which shall meet all the requirements of "Specifications for Gray Iron Castings", ASTM Designation A-48, Class 30. They shall in every respect conform to Lincoln Standard Plans. Dimensions as detailed on the Lincoln Standard Plans shall deviate by no more than plus or minus 1/16 inch. All frames and covers shall be furnished with horizontal bearing surfaces machined and fitted so as to prevent any rocking in the frame when installed. No casting will be accepted that is warped, cracked, that has swells, or that has been plugged or filled.

4. 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 alternates:

H. MANHOLES AND APPURTENANCES (Continued)

(Mixture Proportions by Volume)

Alternate	Portland Cement	Masonry Cement	Hydrated Lime or Lime Putty	Aggregate Loose & Damp
1	½	1	0	Not less than 2-1/4 nor more than 3 times the sum of the volume of the cements and lime used.
2	1	0	1/4-1/2	

5. Precast Manhole Sections, Risers, and Adjusting Rings

Precast concrete manhole sections and risers shall conform to the requirements of "Standard Specification for Precast Reinforced Concrete Manhole Sections" ASTM Designation C-478. Precast manhole base sections shall be manufactured using rubber gasket seals meeting the requirements of "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals" ASTM Designation C-923. When adjusting manhole rim elevations less than 4 inches , the Contractor shall use brick masonry construction. When adjusting rim elevations more than 4 inches, the Contractor shall use precast concrete adjusting rings to bring the manhole cover and frame to proper grade. Precast concrete adjusting rings shall conform to "Standard Specification for Precast Reinforced Concrete Manhole Sections" ASTM Designation C-478.

6. Manhole Joints

Joints between precast manhole sections, risers, and adjusting rings shall be made using either mastic type gaskets or synthetic elastomer type gaskets. Mortar joints shall not be acceptable for manhole sections and risers. Mortar joints shall only be used in conjunction with adjusting rings and brick masonry work in bringing manhole covers and frames to proper grade.

Mastic type gasket joints shall be K.T. Snyder "Ram-Nek", Hamilton-Kent "Kent Seal No. 2", Sheller-Globe "Tac-Tite", or equal. The size of mastic type gaskets shall be as recommended by the manhole manufacturer.

Synthetic elastomer type gasket joints shall meet the same specification set forth for reinforced concrete pipe in Paragraph 22.02 D.1. of this Chapter.

I. SEWER SERVICE PIPE

Sewer service pipe for new or reconstructed sanitary sewer services shall conform to the material requirements as provided in Title 24 of the Lincoln Municipal Code.

22.03 EXCAVATION AND BACKFILL

Trench excavation, backfill, pipe bedding, and pipe foundation materials and methods shall conform to Chapter 20 of these Specifications, except as hereinafter modified for sanitary sewer construction.

Unless otherwise shown on the plans, modified by Special Provisions, or directed by the Project Manager, all plastic pipe shall be bedded with approved materials to at least 4 inches above the top of the pipe.

22.04 CONNECTION TO EXISTING SEWERS

A. TAP MANHOLE AND RECONSTRUCT INVERT

The Contractor shall make all connections to existing sanitary sewers as shown on the plans. Existing manhole bottoms shall, if necessary, be reconstructed in substantially the same manner specified below for new manhole bottoms. The manhole walls shall be reconstructed as directed by the Project Manager. No pipe less than 8 inches in diameter shall be tapped into the manhole.

BASIS OF PAYMENT

Reconstructed manholes built in conformance with these Specifications and accepted by the Project Manager shall be counted and paid for at the contract unit price bid per each for TAP MANHOLE AND RESHAPE 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.

B. CONNECTING DISSIMILAR PIPE

When any dissimilar pipes are joined together, a factory-made adaptor specifically made for the purpose of connecting sewer pipes of differing materials or outside diameters shall be used to make the connection, as provided by the manufacturer's recommendations or as directed by the Project Manager. Concrete collars may also be required to prevent lateral or vertical separation at the joint. Reinforced concrete collars shall conform to the Standard Plans.

BASIS OF PAYMENT

Unless specifically designated on the Plans as extra work items for payment, factory-made adaptors, connectors, and concrete collars 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.

C. TEMPORARY SEWER PLUGGING REQUIREMENTS

The Contractor shall 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 existing wastewater collection lines. Construction work shall not proceed until the necessary plugging has been accomplished.

Prior to line acceptance testing, any and all water and other foreign material must be removed by the Contractor from the new lines by pumping or other means approved by the Project Manager.

The Contractor shall be responsible for checking each plug daily and, if maintenance is required, shall immediately take corrective action by repairing or replacing the plugs, as applicable to the situation.

Temporary plugging during construction shall not be measured or paid for separately but shall be considered subsidiary to the items for which direct payment is made.

D. MANHOLE REMOVAL AND ABANDONMENT

Where called for on the plans, the Contractor shall plug and abandon existing sewer pipes, and either completely remove existing manholes or fill and abandon existing manholes in place. Manholes to be removed shall be totally removed from the existing location and disposed of. The tops of manholes to be filled and abandoned shall be removed, and approved material shall be compacted in the abandoned manhole to the densities required in Chapter 20.

BASIS OF PAYMENT

Plugging of existing sewer pipes shall be considered subsidiary to other items of work for which direct payment is made. REMOVE EXISTING MANHOLE, COMPLETE, shall be counted and paid for at the contract unit price bid per each. FILL AND ABANDON EXISTING MANHOLE, COMPLETE, 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 these Specifications and as accepted by the Project Manager.

22.05 PIPE INSTALLATION

A. HAULING, DELIVERY AND STORAGE OF PIPES

The Contractor shall haul and deliver along the site all pipe, fittings, and appurtenant appliances. In all handling operations, care shall be exercised to avoid damage to the pipes and fittings.

All pipe shall be stored according to manufacturer's recommendation.

Pipes shall be moved by use of pipe slings or by hand carrying. Pipe shall be thoroughly inspected for cracks and other defects. Any pipe which, in the opinion of the Project Manager or observer, has been damaged in any way, shall be rejected and immediately removed from the job site.

B. LAYING THE PIPE

Only one type of pipe shall be used on each project unless specifically called for on the plans or authorized by the Project Manager. The laying of pipe in the finished trenches shall begin at the lowest point in the line with the spigot end laid in the direction of flow. Single pipe lengths shall be lowered into the trench in an approved manner. The pipes shall be laid to the lines and grades indicated on the plans. The line and grade of the pipe shall be controlled by methods approved by the Project Manager. The Contractor shall maintain the following tolerances from true alignment and grade:

Alignment	+/- 3 inches
Grade	+/- 1 inch

Sanitary sewer service wyes shall be located and constructed to the line and grade as indicated on the plans. Construction, marking, and plugging of service stub outs shall be in accordance with the City of Lincoln Standard Plans.

When flexible pipe is used, the Contractor shall construct and install the pipe in accordance with "Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe" ASTM Designation D 2321. Pipes should be set solidly on a firm, uniform bedding, being careful to prevent soil migration and loss of bottom and lateral support of trench boxes, so as to not disturb the pipe and the integrity of the pipe embedment zone already in place. Voids created by movement of trench boxes or supports shall be properly filled and compacted to densities specified herein. If wheel loading is used for compaction, the Contractor shall provide at least 3 feet of cover over top of pipe before beginning compaction. If a hydrohammer or vibratory plat is used, provide at least 4 feet of cover over the top of the pipe. Care shall be taken in preventing excessive point loads on pipe during backfill operations.

All pipe bells shall be in bell holes excavated for this purpose. If the bottom of the trench should, for any reason, be excavated and finished too low, it shall be refilled to the proper point with crushed rock and thoroughly compacted by mechanical tamping, as specified in Chapter 20 of these Specifications. Filling and ramming earth beneath the pipe to raise it to grade will not be permitted. Pipe shall be laid through the location where manholes are to be constructed.

C. JOINTING THE PIPE

1. General

Pipes shall be joined in an approved manner. Open ends of pipes and fittings shall be effectively sealed. When pipe laying is suspended for any reason, watertight bulkheads shall be placed at the end of the pipe.

2. Jointing Pipe

Gasketed joint pipe shall be joined in the following manner: All dirt, mud and foreign substances should be removed from the spigot and bell. Gaskets should be placed in proper position in the bell of the previously installed pipe. Lubricate gasket, bell and spigot ends with an approved lubricant. Home the pipe and check gasket with feeler gauge to ensure proper sealing. All pipe shall be joined per manufacture's recommendations.

D. CURVILINEAR ALIGNMENT

Except where otherwise authorized by the Project Manager, the recommended manufacture guidelines concerning the minimum radius of sanitary sewer pipe shall be followed.

1. Where curvilinear alignment is required using PVC sanitary sewer pipe, the method of forming curves shall be by using uniform joint deflections not to exceed one degree (1°) per joint (unless indicated otherwise by manufacturer's information) and/or using factory-made three degree (3°) couplings in accordance with the table below. Bending of the pipe barrel to achieve curvilinear alignment shall not be permitted.

Pipe Size Inch	Laying Length	Minimum Radius, Feet	
		1° Jt. Defl. Alone	1° Jt. Defl. +3° Cpigs
8-15 (200-450)	6.25*	360	95
	12.5	720	170
	20	1150	255
18 (450)	6.25*	360	120
	12.5	720)	190
	19.5	1120	270
21, 24 (525, 600)	6.25*	345	115
	12.5	690	185
	19.5	1120	270
27 (675)	5.75*	330	115
	11.5	660	180
	19	1090	265

*Half lengths cut and beveled in the field.

Straight sections of reinforced concrete sewer pipe may be installed on curves by opening the outside of the joints in accordance with this Specification. Where reinforced concrete pipe is to be installed on radii smaller than those shown in this Specification, radius or beveled pipe may be used with prior approval of the Project Manager. On curvilinear alignments only, 4 foot and 6 foot lengths of pipe may be used on shorter radii, rather than beveled or radius pipe, at the option of the Contractor.

Reinforced concrete sewer pipe shall have a maximum joint opening of not more than ½ inch.

Pipe Diameter (Inches)	Minimum Radius (Feet) for Given Laying Lengths Using Unbeveled Pipe			
	4 Feet	6 Feet	7.5 Feet	12 Feet
18	184	276	345	552
21	212	318	397	636
24	240	360	450	720
27	268	402	502	804
30	296	444	555	888
33	324	486	607	972
36	352	528	660	1056
42	408	612	765	1224
48	464	696	870	1392
54	520	780	975	1560
60	576	864	1080	1728
66	632	948	1185	1896
71	688	1032	1290	2064
78	744	1116	1395	2232
84	800	1200	1500	2400
90	856	1284	1605	2568

E. BORING, TUNNELING, DIRECTIONAL DRILLING OR JACKING

When called for in the Contract Documents, the pipe shall be bored, tunneled, directional drilled or jacked in place in conformance with Chapter 20 of these Specifications.

F. CURED IN PLACE PIPE (CIPP)

1. General

CIPP installation shall be accomplished by inverting the resin impregnated tube into the existing sanitary sewer pipeline utilizing an inversion standpipe and hydrostatic head. Curing of the CIPP shall be accomplished by circulating hot water/steam to cure the thermosetting resin into a hard impermeable pipe. The tube shall be fabricated to a size that when installed will neatly fit the internal circumference of the sewer designated for CIPP. Allowance for circumferential stretching during insertion shall be made as per manufacturer's standards.

The length of the CIPP shall be that deemed necessary by the Contractor to effectively carry out the insertion and seal at the inlet and outlet points. When cured, the CIPP shall extend from end to end of the sewer segment being lined forming a continuous tight fitting, watertight liner.

2. Preliminary Cleaning and Inspection

Prior to CIPP installation the Contractor shall remove internal deposits and debris as necessary to assure proper liner installation. Inspection and cleaning of the pipeline shall be performed by experienced personnel trained in locating defects and determining the effectiveness of cleaning efforts. If inspection reveals an obstruction not indicated in the plans or specifications that cannot be removed by conventional methods, then the Contractor shall notify the Project Manager.

3. Installation

Prior to initiating the Work, the Contractor shall describe where the liner insertion point is located. The insertion manhole shall be inspected by the Contractor and the Project Manager to insure that sufficient and unobstructed access to the sewer line is available. Any modifications necessary at the insertion manhole shall be reviewed by the Project Manager.

The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A roller system shall be used to uniformly distribute the resin throughout the tube.

The resin impregnated liner shall be inserted through an existing manhole or other approved access by means of an inversion process which utilizes sufficient hydrostatic head to fully extend the liner to the next designated access point. The hydrostatic head shall be adjusted to be of sufficient height to hold the liner snug to the pipe wall and to produce dimples at side opening or connections.

Following liner inversion, the Contractor shall supply a suitable heat source and water recirculation to properly cure the liner. The curing equipment shall be capable of delivering hot water to the far end of the liner and to uniformly raise the water temperature in the entire liner above the temperature required to effect a cure of the resin. This temperature shall be determined by the resin/catalyst employed. The heat source and recirculation equipment shall be fitted with suitable temperature monitors to gauge the water temperature throughout the liner, water temperature entering and leaving the heat exchanger, and to determine when the exothermic reaction occurs. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear to be hard and sound the equipment indicates that the exothermic reaction has occurred. The cure period shall be of a duration recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature in the tube shall be continuous.

22.05 PIPE INSTALLATION (Continued)

F. CURED IN PLACE PIPE (CIPP) (Continued)

3. Installation (Continued)

The Contractor shall cool the hardened CIPP to a temperature below 100 degrees F before relieving the static head on the liner. Cool-down may be accomplished by the introduction of cool water into the inversion tube to replace water being drained from the far end of the liner. Care shall be taken in the release of static head such that a vacuum will not develop damaging the integrity of the installed liner.

The finished CIPP shall be continuous over the entire length of an insertion run and be free from visual defects, such as foreign inclusions, dry spots, pinholes, and delamination. The CIPP shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the CIPP. If the CIPP fails to make a tight seal at any access point to terminating point, the Contractor shall repair seal with a resin mixture compatible with the CIPP. Connection to manholes and insertion through manholes shall be properly sealed by plugging any visible annular space with resin used to impregnate the liner and by utilizing non-shrink grout creating a watertight seal. Any defects that will affect, in the foreseeable future, or warranty period, the integrity or strength of the CIPP, shall be repaired at the Contractor's expense, in a manner mutually agreed by the City and the Contractor.

G. BASIS OF PAYMENT

SOLID AND COMPOSITE WALL PIPES

All pipe of the various types shall be measured and paid for at the contract unit price bid for each size per linear foot. 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 a workmanlike manner acceptable to the Project Manager. 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 plans and in the proposal.

CURED IN PLACE PIPE

The CIPP, complete and in place, shall be measured from the inside face of the manhole on each end of the liner. Payment for the CIPP shall be made at the Contract unit price per linear foot for CIPP, IN PLACE. Such payment shall be full compensation for liner fabrication, mobilization, inserting the liner tube, expanding the liner tube, curing the liner tube, sealing the ends, by-pass pumping the normal flows, and all other materials, internal TV inspection before and after liner installation, video tape documentation, equipment, tools, labor, and incidentals necessary to complete the work called for on the plans.

22.06 HIGHWAY, STREET, RAILROAD AND UTILITY CROSSINGS

Highway, street, railroad and utility crossings shall be constructed as indicated on the plans or as specified in the Special Provisions. The City will obtain the necessary permits. Encasements shall conform to Chapter 20 of these Specifications.

In laying pressure type sewer pipe under a railroad track or over/under a water main, the center of a standard length of pipe shall be centered with the centerline of the rails or water main. (See Section 23.07 D.)

22.07 SANITARY MANHOLE CONSTRUCTION

A. MANHOLE BOTTOM

The bottom of each manhole shall be constructed of concrete or precast concrete manhole base sections, as specified in Section 22.02 herein. The manhole bottom and inverts shall be constructed as indicated in the plans. The pipe shall be adequately supported during the construction of the base.

When constructing a poured concrete manhole floor, manhole water stops shall be installed on all plastic pipes entering manhole walls. The water stop gasket shall be placed within 1 inch of the center of the manhole wall. The top of the poured manhole floor shall be as indicated on the LSP for type of sanitary manhole being constructed.

Care shall be taken to place the water stop fingers pointing toward the outside of the wall of the manhole. Water stop tightening bands shall be adjusted with socket wrenches to ensure a snug fit. Screwdriver tightening will not be acceptable.

Pipe shall be laid through manholes. The upper portion of the pipe shall be removed after other manhole construction is complete and all debris is removed from the manhole. Where plugs are required on pipe stubs, solvent weld caps shall be installed on all plastic pipe. Follow manufacture's recommendations for sealing cut sections of pipe.

Integral precast concrete manhole bottom sections are acceptable. If utilized, all pipe entrance and exit locations shall have water tight compression joints made of rubber which are integrally cast into manhole wall (A-loc or equal). The flexible joints shall meet "Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals" ASTM Designation C 923 for manufacture and meet performance and test requirements of "Standard Specification Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines" ASTM Designation C 969 or "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure ASTM Designation C 1244. In no case, will the Contractor be allowed to construct pipe enter/exit points on new manholes by breaking out precast to the elevations and deflection angle as shown on the plans. Pipes shall not be laid through manholes when utilizing integral precast manhole base sections. Following placement of the manhole base section and insertion of pipes through manhole wall, the manhole floor and concrete fillet work shall proceed as shown on the plans.

B. MANHOLE ADJUSTING RINGS

Precast concrete grade rings may be used to adjust the manhole ring and cover to the required grade when the vertical adjustment is greater than 4 inches. At least one (1) 4 inch grade ring shall be used to allow for future adjustments. Approved mastic type gaskets shall be used to seal the joints between precast adjusting rings, the upper manhole riser, and the cast iron manhole frame (ring). The outside of the cast iron manhole frame shall be finished off with mortar as shown on the Standard Plans.

Brick adjusting rings are not allowed.

22.07 MANHOLE CONSTRUCTION (Continued)

C. POURED CONCRETE MANHOLES

The Contractor may construct concrete manholes in accordance with the Lincoln Standard Plans.

Reducing sections shall be eccentric, as indicated on the Standard Details. Cast-in-place concrete manholes shall be constructed with L3500 Concrete, as specified in Chapter 11. Forms shall have adequate bracing, be in good repair and of a manufacture approved by the Project Manager. Concrete shall be carefully placed and thoroughly consolidated to the greatest density possible. All holes, joints, or honeycombed sections shall be carefully filled and sealed with mortar.

D. PRECAST CONCRETE MANHOLE SECTIONS

Concrete manholes may also be constructed of precast sections. In the assembly of the wall sections, exercise care in the placement of gaskets to ensure watertight joints. Bottom precast sections shall be placed on top of a double ring of approved mastic type gaskets. All lift holes in precast sections shall be completely filled with an approved non-shrink grout

E. COLD WEATHER CONSTRUCTION

The Contractor shall take all reasonable precautions to protect all parts of the work from damage due to freezing or as a result of winter weather conditions. The Contractor shall cover and protect all brick and concrete masonry and shall supply artificial heat, if necessary, in order that the temperature of such masonry work shall not fall below 45° degrees F for a period of at least seventy two (72) hours after the structure has been constructed.

BASIS OF PAYMENT

STANDARD MANHOLES shall be measured and paid for at the contract unit price bid per each for each type of manhole. This price shall be full compensation for the cast iron ring and cover, the brick adjustment or precast grade rings when required, the manhole floor, and all labor, tools, equipment and incidentals necessary to install these items. STANDARD MANHOLES shall also be measured from the flow line to the top of rim and paid for at the contract unit price bid per vertical foot for each type of manhole. This payment shall be full compensation for all steps, eccentric manhole sections, manhole barrel sections, drop pipes, fittings, joints, labor, materials, tools, equipment and incidentals necessary to complete each type of manhole in a manner acceptable to the Project Manager.

22.08 SEWER SERVICES - CONSTRUCTION AND RECONSTRUCTION

A. GENERAL

Where shown on the plans or as directed by the Project Manager, sewer services shall be constructed or reconstructed as necessary. All work by the Contractor on sewer service shall be performed as provided in Title 24 of the Lincoln Municipal Code (L.M.C.) and by the Lincoln Plumbing Code. These codes shall be strictly adhered to under all conditions.

All construction or reconstruction shall be made using materials approved by the Lincoln Municipal Code.

B. CONSTRUCTION OF SEWER SERVICES

Where called for on the plans, new sanitary sewer services shall be constructed under cul-de-sacs or other future paving. Generally the location will be from the location of the "Y" fitting, as shown on the plans, to a specified location on the right-of-way for adjacent properties. "Y" fittings shall be of a type compatible with the sewer main pipe being laid.

C. RECONSTRUCTION OF SEWER SERVICES

Where called for on the plans or as directed by the Project Manager, sewer services shall be reconstructed to the location of the newly constructed sewer main or to raise, lower, or realign the service to avoid conflict with the utility being constructed.

Where the reconstructed line will lie within 18 inches vertically of the utility being constructed, the line shall be cast iron soil pipe, bell end spigot, service weight or heavier; ductile iron pipe, Class 52 with polyethylene encasement; Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) ASTM D-2241 PVC pipe, Class 160, with push-on gasketed joints. All other reconstructions shall be any of the approved materials. Replacement services shall be extended to the distance from the main required to provide positive slopes. Fittings of the same material as pipe being used may be required when extreme changes in elevations or alignments are necessary.

Where new taps are deemed necessary by the Project Manager, they shall be scheduled with, and made by, the Wastewater Collection Section of the Lincoln Wastewater System.

The Contractor shall obtain all necessary tapping permits required through City Building & Safety Department. Tapping saddles, taps, and plugs for abandonment will be supplied at no additional cost to the Contractor. The Contractor will be responsible for all excavation and backfilling and supply of all other materials and labor required.

Where possible, the Project Manager may direct that the sewer service pipe be bored under existing paving or other utilities or structures.

BASIS OF PAYMENT

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, all as accepted by the Project Manager.

Measurement and payment will be made at the contract unit price bid per linear foot for SEWER SERVICE PIPE for each size required. 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 as accepted by the Project Manager.

Boring for sewer service pipe shall be measured and paid for at the contract unit price bid per linear foot for BORING FOR SEWER SERVICE PIPE. Such payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to produce the bore hole ready to receive the sewer service pipe, as accepted by the Project Manager. The pipe to be placed in the bore hole shall be paid for as provided above.

22.09 TESTING

A. GENERAL

Line acceptance tests shall be required for each section of sanitary sewer constructed between manholes or junction structures. Line acceptance tests shall consist of hydrostatic or low pressure air testing for leakage; deflection testing for all plastic pipe; and internal television inspection. In addition, all PVC pipe furnished under the Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings ASTM F-679 reference specification shall be checked to ascertain that the pipe being furnished meets the acceptable T-1 minimum wall thickness requirements. Manholes and junction structures shall also be tested for acceptable performance as hereinafter provided. Except for said T-1 wall thickness checking, the tests specified below 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.

The Contractor shall furnish all labor, tools, and equipment to perform all the tests specified hereinafter and only in the presence of the Project Manager or observer, except where such tests are specifically designated as being the responsibility of the City. The methods and the equipment used for the tests shall be approved by the Project Manager. No direct payment will be made for the testing required herein. The costs associated with the testing are to be considered subsidiary to the costs of the sewer lines and manholes.

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 Project Manager, live wastewater flow shall not be permitted in the sanitary sewer line until <u>all</u> of the following tests are completed and found acceptable. With the Project Manager's approval, dry taps to the new line may be permitted prior to testing, provided that the service line stub outs are temporarily capped off in an air-tight manner.

B. LINE ACCEPTANCE TESTS

1. Hydrostatic Tests

The following hydrostatic test may be used to meet line leakage testing requirements, or, alternately, the Contractor may at his option substitute the low pressure air testing procedure specified below. For hydrostatic testing, the maximum acceptable leakage rate shall be 0.0016 gallons per hour per lineal foot per inch) diameter. The minimum head at the upper manhole or structure shall be 5 feet more than the groundwater level surrounding the pipe. The groundwater level shall be ascertained prior to testing by connecting a clear plastic tube to the pipe nipple installed under Paragraph 22.07 A. of this chapter. The pipe nipple shall then be capped. The Contractor shall use a stand pipe not greater than 4 inches in diameter that is connected to a plug in the segment to be tested. The stand pipe shall be of sufficient length to maintain the proper test head. The test period shall be for a minimum of one (1) hour. If the leakage rate is in excess of the amount specified above, the Contractor shall make such repairs as are necessary and retest the line until these requirements are met.

The Contractor, at his option, may combine the above hydrostatic test with the exfiltration tests for the connecting manholes or structures specified in Paragraph 22.09 B. 2. hereinafter, provided that the highest test head and longest test time for the line segment and manholes in combination are met. If the combined leakage <u>rate</u> allowance is exceeded, the Contractor shall isolate the problem(s), make the necessary repairs, and retest the line segment and manholes separately or in combination until found acceptable.

2. Air Tests

Low pressure air testing may be used in lieu of hydrostatic testing specified above. The equipment shall be supplied with positive on/off valves and regulator relief valves set at no more than 8 psig for pressurizing the sewer line. The pressure gauge shall have a range of zero to ten psig, with 0.1 psig divisions and an accuracy of 0.05 psig. The pressure gauge shall have been calibrated and certified as to accuracy within the past year. The Contractor may be directed to obtain a suitable pressure gauge if for any reason the gauge on hand has questionable accuracy.

The test procedures required shall be as follows:

a. Prior to testing, the backfill shall have been placed and compaction requirements fully met, and the line shall have been cleaned of all foreign matter.

b. All equipment shall be checked for proper functioning prior to actual line testing. Use one (1) length of spare pipe laid on the ground; pressurize pneumatic plugs on each end to 25 psig; and internally pressurize the pipe to 5 psig. The plugs shall hold without bracing, and the line pressure gauge shall show no loss of air. Exercise proper safety precautions around the pressurized line in being prepared for possible blow out of the plugs.

c. After checking out all equipment, proceed with actual line testing. Insert the pneumatic plugs at each end of the test segment; extend air lines to the top of the manhole; make sure no personnel remain in the manholes; then carefully pressurize the plugs to 25 psig. Low pressure air shall be introduced into the sealed line until the internal pressure reaches 4 psig greater than the average groundwater head around the pipe (one foot of water head is equivalent to 0.433 psig). Allow at least two (2) minutes for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air supply to the control panel shall be disconnected.

d. The portion of the line being tested shall be termed acceptable if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the equivalent average groundwater pressure that may be over the pipe) shall not be less than the time shown in the following table:

Pipe Diameter in inches	t_{min}, (Minutes)
6 (150)	2.8
8 (200)	3.8
10 (250)	4.7
12 (300)	5.7
15 (350)	7.1
18 (450)	8.5
21 (525)	9.9
24 (600)	11.3
27 (675)	12.7
30 (750)	14.2
36 (900)	17.0
42 (1050)	19.8

e. On sewers large enough to permit entry by personnel, the Contractor may air test individual joints using the same acceptance criteria as specified above, provided the equipment and procedures are first approved by the Project Manager.

3. Television Inspection

Internal television inspection of new sanitary sewers will be performed by the City on a cost per foot basis at no cost to the Contractor. The prevailing TV inspection cost can be obtained from the department of Public Works/Utilities Business Office. In most cases, television inspection will be scheduled no earlier than thirty (30) days after the installation of the pipe and shall be done at the same time and in conjunction with final deflection testing, as specified below, and after all line leakage and manhole exfiltration testing has been completed and found acceptable. Televised lines shall be termed ‘acceptable’ if no defects are found, such as open joints, breaks, cracks, excessive pipe deformation, intrusions, depositions and debris left in the line, or excessive vertical or horizontal misalignment. 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 to the Contractor at the prevailing TV inspection rate.

4. Deflection Testing

Deflection tests shall be made on all pipe installed on the project. The Contractor is encouraged to perform his own preliminary deflection testing to screen out obvious defects prior to completing other work that may later be disturbed by re-excavation to repair defects.

Final deflection testing shall not be done sooner than thirty (30) days after backfill has been compacted in place by the Contractor, unless the time limitation is expressly waived by the Project Manager. The maximum allowable deflection for any pipe shall be five percent (5%) of the base inside diameter of the pipe.

The mandrel shall be pulled through the test segment using a pulling force equivalent to hand power. The line shall be termed "acceptable" if, during final deflection testing, the mandrel passes completely through the line without restriction. 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.

If excessive deflection is indicated, the Contractor shall make necessary repairs at his own expense and the line retested until found acceptable. No additional time waiting period shall apply for retesting following repair of the line and proper recompaction of the backfill, unless otherwise directed by the Project Manager.

On any pipe size 8" to 18" the City will perform the mandrel test, at no cost to the Contractor.

On any pipe size greater then 18", it will be the responsibility of the Contractor to perform the mandrel test with City staff in observance.

On 36" and larger diameter piping, hand testing is acceptable with an approved plan by the Project Manager and with City staff in observance.

C. MANHOLE PERFORMANCE TESTS

1. General

All manholes shall be constructed so as to be free from infiltration. The interior of the manhole shall be observed during the flushing operation for location of any deficiencies. The manhole shall also remain free from visible infiltration during the two-year period of guarantee. If any infiltration is observed during that period, the Contractor shall be required to make any necessary repairs.

2. Exfiltration Tests

Exfiltration tests shall be performed on all manholes and pipe junction structures, except where groundwater conditions do not permit proper test head levels to be achieved, as specified below. Test procedures shall be as follows:

a. Insert pneumatic plugs in all lines entering and leaving the man- hole. Extend air lines to the top of the manhole, and make sure all personnel are out of the manhole. Carefully pressurize each plug to25 psig to seal each line.

b. Fill the manhole to a level at lease 5 feet above the groundwater level surrounding the manhole, or to an 8 foot depth, whichever is higher. Allow the water to stand until maximum absorption has been reached, then refill the manhole if necessary to its original depth. If the required test head would be higher than the bottom of the frame for the manhole cover, either the exfiltration test head shall be decreased or the test waived, at the discretion of the Project Manager.

c. After the manhole has been refilled, the manhole exfiltration test shall begin and shall last for a period of at least four (4) hours. The manhole shall be considered "acceptable" if the equivalent rate of exfiltration (leakage) does not exceed 0.0016 gallons per hour per vertical foot of test head per inch diameter of the manhole. For convenience, the following table may be used to evaluate allowable leakage rate (for the cylindrical portion of the manhole only; for other structural shapes, adjust the maximum leakage rate and head drop on the basis of equivalent diameter for the same perimeter):

ALLOWABLE MANHOLE LEAKAGE RATES FOR
MANHOLE EXFILTRATION TEST

Nominal Manhole Diameter inches	Manhole Volume gal. per VF	Maximum Leakage Rate gal./ VF / hr.*	Maximum 4-Hr. Head Drop* inches
4	94	0.08	0.30
5	147	0.10	0.25
6	211	0.12	0.20

*At 8 foot test head.

C. Vacuum Testing

Vacuum testing of manholes, when used, shall be performed on all manholes and pipe junction structures to conform to the requirements of Standard Test Method for Concrete Sewer Manholes by the Negative Aire Pressure (Vacuum) Test" ASTM Designation C 1244. Test procedures shall be as follows:

a. All lift holes shall be plugged with an approved non-shrink grout.

b. All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole.

c. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendation. Top of the manhole is considered to be the top of the casting forming the manhole lid.

d. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop 9 inches of mercury. The manhole shall pass if the time is greater that the time listed in the table on the preceding page for the depth and diameter of the manhole being tested.

e. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

Minimum Test Times for Various Manhole Diameters

Diameter inches									
Depth feet	30	33	36	42	48	54	60	66	72
Time- sec.									
8 (2.4)	11	12	14	17	20	23	26	29	33
10 (3.0)	14	15	18	21	25	29	33	36	41
12 (3.7)	17	18	21	25	30	35	39	43	49
14 (4.3)	20	21	25	30	35	41	46	51	57
16 (4.9)	22	24	29	34	40	46	52	56	67
18 (5.5)	25	27	32	38	45	52	59	65	73
20 (6.1)	28	30	35	42	50	53	65	72	81
22 (6.7)	31	33	39	46	55	64	72	79	89
24 (7.3)	33	36	42	51	59	64	78	87	97
26 (7.9)	36	39	46	55	64	75	85	94	105
28 (8.5)	39	42	49	59	69	81	91	101	113
30 (9.1)	42	45	53	63	74	87	98	108	121

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; leakage testing for all pipe and manholes is complete and accepted; paving, sidewalks, and driveways are replaced; and final clean up and park space are finished.

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 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 Project Manager. Eligibility for final acceptance shall not be delayed for more than sixty (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.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 23

WATER MAINS

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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 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 11 Portland Cement Concrete
Chapter 20 Construction for Utilities and Structures
Chapter 22 Sanitary Sewers

23.02 MATERIALS AND SERVICES PURCHASED FROM THE CITY

The Contractor shall purchase the following materials and services from the Lincoln Water System:

- Valves
- Valve boxes, rings and lids
- Fire hydrants ensuring model and configuration for proper nozzle orientation
- Hydrant extensions and installation of extensions
- Hydrant orientation when required
- Pressure taps and abandonments, including tapping sleeves and valves, corporation stops, and all labor and equipment for installation or abandonment
- Flushing and disinfection services and materials
- Operation of valves including applicable fees for water main shutdowns and disruption of service when applicable

The above materials are available for inspection at the Lincoln Water System Shop. The Contractor shall provide all labor and transportation for loading and hauling of said materials.

Water will be supplied to the Contractor in accordance with the General Conditions and Title 17 of the Lincoln Municipal Code.

All materials and services will be billed to the Contractor at prices and rates established by the Public Utilities Business Office. Contractors may obtain the current material prices, labor and equipment rates from the Public Utilities Business Office.

23.03 CONTRACTOR SUPPLIED MATERIALS

A. REFERENCED STANDARDS

1. American National Standards Institute (ANSI). All referenced standards shall be the latest revision thereof

   a. A21.51 - American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

   b. A21.10 - Gray Iron and Ductile Iron Fittings, three-inch through 48-inch, for Water and Other Liquids.

   c. A21.11 - Rubber Gasket joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.

   d. A21.15 - Flanged Cast Iron and Ductile Iron Pipe with Threaded Flanges for Cast Iron and Ductile Iron Pipe and Fittings for Water.

   e. A21.4 - Cement-Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water.

   f. A21.5 - Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids.

   g. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

   h. A21.53 - Ductile Iron Compact Fittings, three-inch through twelve-inch, for water and other liquids.

2. American Water Works Association (AWWA)

   a. C301 - Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.

   b. C651- Disinfection Water Mains.

   c. C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inch Through 12 Inch for Water Distribution.

   d. C905 - Polyvinyl Chloride Pipe (PVC) Pressure Pipe and Fabricated Fittings, 14 Inch Through 48 Inch for Water Distribution

3. American Society for Testing and Materials (ASTM)

   a. A615 - Specifications for Deformed and Plain Billet-Steel.

   b. A617 - Specifications for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

   c. B88 - Specification for Seamless Copper Water Tube

B. JOINT TYPES

1. Push-on joints shall conform to the requirements of ANSI 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 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.

   c. All retainer glands shall utilize a wedge action principle to fully restrain the fitting and pipe together. Wedge action retainer glands shall be EBAA Iron Sales “Megalug”, Tyle Pipe MJR Gland, Romac Industries GripRing, or approved equal. Retainer glands shall be fabricated from ductile iron and shall have the letters “DI” or the works “Ductile Iron” cast into the gland.

      Retainer glands shall be supplied clearly tagged or otherwise marked for use with either PVC or Ductile Iron pipe depending on the pipe material being used.

      Retainer glands shall use the following minimum number of wedges for each pipe size and pipe material shown below:

Nominal Pipe Size (inches)	Minimum wedges per gland PVC Pipe	Minimum wedges per gland Ductile Iron Pipe
6	6	3
8	6	4
12	8	8
16	12	12
24	16	16

B. JOINT TYPES (Continued)

5. Flange connections shall conform to the requirements of ANSI B16.1 for 125-pound class and shall also conform to ANSI A21.15. The flange gaskets shall be 1/8 inch 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 ½ inch of the bolt beyond the outer face of the nut when the joint is fully assembled.

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 one (1) part Portland or mortar cement to two (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 inches wide for all pipes 36 inches in diameter or smaller. All diapers for pipes larger than 36 inches shall be a minimum of 7 inches 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 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 A21.4. Unless otherwise specified, all pipe shall be supplied in 18 or 20 foot lengths and shall have push-on type joints.

F. PRESTRESSED CONCRETE CYLINDER PIPE

Prestressed concrete cylinder pipe shall be manufactured in accordance with AWWA C301 and shall be designed in accordance 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.

G. POLYVINYL CHLORIDE (PVC) PIPE

Polyvinyl Chloride (PVC) pipe shall conform to AWWA C900 or C905. All pipe 12 inches in diameter or smaller shall be PVC 1120 DR 14 with O.D. conforming to that of cast iron pipe unless otherwise specified. PVC pipe larger than 12 inches 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. CAST IRON AND DUCTILE IRON FITTINGS

Cast iron and ductile iron fittings shall conform to the requirements of ANSI A21.10 and shall be supplied with a standard weight cement mortar lining conforming to ANSI 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 accordance with ANSI A.21.53. 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 inch nominal diameter and smaller, based on the diameter of the largest bell. For fittings larger than 12 inch nominal diameter, a pressure rating of 150 p.s.i. shall be used unless otherwise specified.

I. 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 nine (90) degree elbow with two (2) swivel couplings, Anchor elbows shall be similar to the Tyler Pipe Swivel x Swivel 90 degree ELL swivel fittings.

Anchor pipe shall consist of a length of pipe with two (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.

J. 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 accordance 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.

K. CONCRETE AND REINFORCING STEEL

Concrete shall be L3500 conforming to Chapter 11 of these 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.

L. POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be Class C, black pigmented, 8 mils. thick, linear low density, polyethylene conforming to the requirements of ANSI 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 the following dimensions:

Nominal Pipe Diameter (inches)	Polyethylene Encasement Tube and Sheet Widths (inches)	
	Tube	Sheet
6	20	40
8	24	48
2	30	60
16	37	74
24	54	108
30	67	134
36	81	162
48	108	216
54	121	242

M. 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.

N. 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.

O. HYDRANT DRAIN MATERIAL

Hydrant drain material shall be clean, washed, uniformly graded pea gravel conforming to the following gradations:

Sieve Size	% of Aggregate Coarser than Stated
½"	0
#4	90
#8	95

P. AIR RELIEF VALVES

Air relief valves shall be provided by the Contractor to conform to the size, type and configuration shown on the plans.

Q. TRACER WIRE

Wire used for locating PVC pipe shall be THNN 14 gauge copper.

All splices and connection shall be made using direct bury 100% waterproof connectors.

23.04 REMOVED MATERIALS

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. 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 Project Manager or the observer.

BASIS OF PAYMENT

Water main pipe removed in accordance with these Specifications and accepted by the Project Manager shall be measured and paid for at the contract unit price bid per linear foot for REMOVE ___ FEET OF 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.

BASIS OF PAYMENT (Continued)

Water main valves, hydrants and plugs removed and relayed, removed and salvaged, or removed in accordance with these Specifications and accepted by the 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 accordance 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.

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 feet or in accordance with manufacturers recommendations whichever is less. Ductile iron pipe shall not be stacked higher than allowed in the following table:

Pipe Size (inches)	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 Project Manager, all PVC pipe shall be embedded with approved materials to at least 4 inches 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 accordance to manufacturer's requirements and instructions except where otherwise provided in the specifications. Prior to beginning work, the Contractor shall submit to the 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.

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 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 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 Project Manager. When twelve (12) inch butterfly valves are called for on the plans for PVC pipe, the pipe ends shall be chambered on the inside radius as detailed in the Lincoln Standard Plans so that the valve operates to a fully closed position.

23.07 INSTALLATION OF PIPE FITTINGS (Continued)

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 plug the open ends of all pipes, Plugs shall be capable of preventing the entry of water and other foreign material with the excavation completely full of water.

All pipe shall be jointed immediately after placement in the excavation. Bells 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.

D. UTILITY CONFLICTS

Where unforeseen conflicts between the water construction and existing utilities are discovered, the Contractor shall immediately notify the Project Manager. Where the water main is to be constructed below or within 18 inches of any 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 one (1) 20 foot length of pressure pipe material as provided in Section 22.02(B), 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 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. 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 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. All hydrant drain holes and valve operators shall be protected from concrete during construction of the thrust blocks.

When the existing water mains must be reconstructed or looped, the Contractor shall restrain all fittings with ductile iron retainer glands installed in accordance with the manufacturer's recommendations in addition to concrete thrust blocks and/or anchorages.

F. TRACER WIRE

The Contractor shall install tracer wire in the trench adjacent to the pipe, with PVC pipe only. Tracer wire shall be extended to the ground surface and terminated in accordance with the Standard Plans using a coil of excess wire at least two (2) feet in length inside the termination box. Installation of tracer wire shall be considered subsidiary to the installation of PVC pipe. Tracer wires shall be tested 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.

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 the following:

Maximum Joint Deflections for Ductile Iron						
Pipe Diameter (Inches)	Push-on Joints			Mechanical Joints		
	Deflection Angle (Degrees)	Maximum Offset (inches)	Minimum Curve Radius (feet)	Deflection Angle (Degrees)	Maximum Offset (inches)	Minimum Curve Radius (feet)
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

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 required reassembly. 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. Bell ends shall be protected during joining by approved methods.

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' 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 the following table:

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 inches 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:

Pipe Diameter (Inches)	Maximum Joint Opening (Inches)
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 diaper with a wire curved to conform to the radius of the pipe.

H. POLYETHYLENE ENCASEMENT

The Contractor shall double wrap and seal with tape all bolted connections, anchoring couplings, anchoring elbows, valves, and fire hydrants. The Contractor shall ensure that hydrant drain holes are not blocked or covered. The Contractor shall wrap all service pipes from the tap extending 3 feet (1 m) away from the main, and shall repair all polywrap at the tap location. When called for on the plans, the Contractor shall also double wrap the entire pipe in polyethylene encasement. Whenever PVC or other pipe is used or specified, all cast iron or other metallic fittings and appurtenances shall be double wrapped in polyethylene encasement.

All polyethylene encasements shall be installed using Methods A or B as detailed in ANSI A21.5.

I. WATER MAIN SHUTDOWNS

All water main shutdowns shall be performed by Lincoln Water System personnel upon request from the Contractor.

At least forty eight (48) hours prior to the time that tapping, valve operation, flushing or disinfection services are required, the Contractor shall notify the Assistant Superintendent of Water Construction or his representatives to provide for scheduling such services. These services shall be scheduled only during normal City working hours.

Additional notice shall be required when critical water customers such as industries, schools, day cares, medical facilities, etc are impacted by the shutdown. Interruptions of water service to critical customers may require work to be performed after normal work hours or on weekends. The Lincoln Water System shall notify the Contractor when critical customers are connected to the water main planned for shutdown.

Service fees charged for water main shutdowns shall be considered subsidiary to the cost of installation of the water main or the cost of the reconstructing or looping the water main or water services in the event of a utility conflict

BASIS OF PAYMENT

The installation and jointing of pipe and fittings will not be measured or paid for separately. Cost of this work shall be merged with and considered subsidiary to the cost of the various pipes and fittings for which direct payment is made.

Unless otherwise specified, polyethylene encasements shall not be measured and paid for separately. The cost of polyethylene encasement shall be considered subsidiary to the cost of those items for which direct payment is made.

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 accordance with these Specifications and as accepted by the Project Manager.

POLY VINYL 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 accordance with these Specifications and as accepted by the 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.

23.07 INSTALLATION OF PIPE AND FITTINGS (Continued)

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 Project Manager.

CONCRETE FOR THRUST BLOCKS AND ANCHORAGES shall not be measured for payment. Payment will be based on the concrete volumes shown on the Lincoln Standard Plans for thrust blocks and anchorages actually installed and will be made at the contract unit price bid per cubic yard for blocks constructed in conformance with the drawings, these Specifications, and accepted by the Project Manager..

REINFORCING STEEL FOR THRUST BLOCKS AND ANCHORAGES will not be measured for payment. Payment will be based on the weights shown on the Lincoln Standard Plans for thrust blocks and anchorages actually installed and will be made at the contract unit price bid per pound for blocks constructed in conformance with the drawings, these Specifications, and accepted by the Project Manager.

23.08 INSTALLATION OF VALVES AND HYDRANTS

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.

Valves 12 inches in diameter and larger shall be installed resting on one or more precast concrete support blocks 18 inches square and 4 inches thick which bear against undisturbed earth.

The Contract 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 contract 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.

Hydrants shall be set plumb, resting on a precast concrete pad, 4 inches thick and 18 inches square. The support pad 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 Contract shall make appropriate deflections or rotations in the tee and anchoring elbow, or use an anchoring offset, to meet this grade. Where a hydrant extension is necessary to meet the required grade, the hydrant extension shall be installed only by LWS. 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 Project Manager or that person's representative when hydrant extension are required.

The Contractor shall place a minimum of 2 cubic feet of hydrant drain material around the base of the hydrant to allow free ready drainage of the barrel.

23.08 INSTALLATION OF VALVES AND HYDRANTS (Continued)

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 accessed to the Contractor. These fees shall be considered subsidiary to the cost of installing t he water main and shall not be cause for additional compensation by the Contractor.

Backfill shall be accomplished in accordance with the provisions of Chapter 20 of these Specifications, except that all backfill within 3 feet of all hydrants and valve boxes shall be compacted to 95% of maximum dry density as measured by AASHTO Method T-99.

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 accordance with these Specifications and as accepted by the 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 feet or L=6.5 feet. Such price shall be full compensation for all loading, hauling, installation, thrust blocking, hydrant drain material, hydrant extensions, backfilling, labor, tools, materials, equipment and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager. Temporary hydrants used for flushing and disinfection of mains shall be not be paid for separately but shall be considered subsidiary to the installation of the mains.

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 LWS, hydrant extension kits, labor, tools, materials, equipment and incidentals necessary to complete the work in accordance with these Specifications and as accepted by the Project Manager. The unit price for HYDRANT EXTENSION, COMPLETE shall be an established unit price per each in the bid proposal.

23.09 TEMPORARY HYDRANTS AND BLOW-OFF FOR FLUSHING AND DISINFECTION

Temporary hydrants and blowoffs 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 accordance to AWWA C651. The installation of temporary hydrants and blowoffs 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 of downstream facilities or property.

The installation of temporary hydrants and blowoffs, necessary erosion protection, discharge water conveyance and downstream protection and the removal of temporary hydrants and blowoffs shall be subsidiary to the cost of water main installation.

23.10 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION

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.

23.10 WATER SERVICE CONSTRUCTION OR RECONSTRUCTION (Continued)

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 5 feet. Minimum lateral clearance from structures open to the weather, such as storm sewer inlets, shall be 3 feet. All other clearance shall be a minimum of 6 inches.

The Contractor shall place all reconstructed water services or looped water services so as to provide a minimum cover of 5 feet. Minimum lateral clearance from structures open to the weather, such as storm sewer inlets, shall be 3 feet. All other clearance shall be a minimum of 6 inches.

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 feet of said excavation. When the break in the service line is within 5 feet 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 one (1) joint will be allowed. When the break in the service line is beyond 5 feet 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.

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 Project Managers 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 3/4inch.

New curb stops and boxes may be required when the service is reconstructed to the curb stop. Such curb stop may be ordered replaced because of 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. The Contractor shall be responsible for excavation, backfill, sod, pavement and other incidentals necessary to complete the abandonment.

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, labor including the licensed plumber, excavation, backfill, sod, clean-up and incidentals necessary to install the pipe in a manner acceptable to the 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 Project Manager. Water service pipe to be placed in the bore hole shall be paid for as provided above.

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 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, 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 Project Manager.

23.11 ABANDONMENT OF WATER MAIN (IN PLACE)

When existing water mains are shown to be abandoned in place on the plans, the Contractor shall turn all valves to the off position, remove one (1) or more feet of the top section of the valve box, fill with sand and cap or plug with concrete, and plug each end of the abandoned water main segment with concrete. ABANDONMENT OF WATER MAIN (IN PLACE) 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 Project Manager.

23.12 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.

23.13 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 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.

23.13 TESTING (Continued)

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 for a minimum of two (2) hours, carefully measuring all water added to the system during that period. The rate of water added per 1,000 feet of pipeline shall not exceed the following:

Nominal Pipe Size (inches)	Maximum Allowable Rate (gallons/hour)	Test Pressure (psi)
6	0.64	200
8	0.85	200
12	1.28	200
16	1.47	150
24	2.21	150
30	2.76	150
36	3.31	150
48	4.41	150
54	4.97	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 for paid for directly. Testing shall be considered subsidiary to those items for which direct payment is made.

23.14 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 inch and smaller, the Contractor shall provide for the scheduling of the flushing and disinfection by the Lincoln Water System at least twenty-four (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.

23.14 DISINFECTION OF THE COMPLETED WORK (Continued)

For water mains 30 inch and larger, the Contractor shall provide a flushing and disinfection plan to the 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 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

23.15 COLD WEATHER CONSTRUCTION

All construction performed in cold weather or during periods where frost penetration of the soil exceeds 6 inches shall be in accordance with Chapter 20 of these Specifications.

23.16 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.

23.17 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 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 accordance 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 Project Manager.

23.18 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.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 24

TRAFFIC SIGNAL AND STREET LIGHTING

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CHAPTER 24

TRAFFIC SIGNAL AND STREET LIGHTING

24.00 GENERAL

A. QUALIFIED PERSONNEL

A certified and qualified journeyman lineman shall be on the job site to supervise the pulling of the fiber, splicing of wire where permitted, and to perform the task of final connections in all signal indications, push buttons, detectors, cameras, and dynamic message signs. A licensed and qualified journeyman electrician shall wire the cabinet. Proof of certification or license of individuals on job site will be required at the pre-construction meeting. All workers on the job site shall have International Municipal Signal Association (IMSA) Traffic Signal Level 1 certification or approved equivalent within one year of employment.

B. 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 accordance with the plans and these Specifications. When the item is furnished by the City the item of payment is prefaced by the word, “Install”.

Furnished materials can be picked up at Traffic Operations storage locations (traffic signal items) between 7:30 a.m. to 8:30 a.m. weekdays with 24 hour notice, with the exception of city holidays, or Lincoln Electric System Stores Facility, (street lighting items), 27th and Fairfield Streets, Lincoln, Nebraska. Further direction may be required either by Special Provision or by the Engineer. Refer to Section V; “Control of Materials”, Subsection F. “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 cost of damaged materials 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 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 accordance with the Plans, Specifications, or the Special Provisions.

24.00 GENERAL (Continued)

C. ELECTRICAL SERVICE APPLICATIONS

The Contractor shall make arrangements with Lincoln Electric System for power service in a timely manner. Any delay resulting from a Contractor's untimely request to the local utility for power service shall not be justification for the suspension 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 Engineer.

D. ENERGIZING TRAFFIC SIGNALS

It is the intent of this Specification to minimize interruption to both vehicular and pedestrian traffic and activities in the area adjacent to the described work.

Prior to a new or rebuilt signal being turned on, in flashing or permanent operation, the Contractor shall have completed all splices; including signal display, detection, power, pre-emption, and flash testing of the completed installation.

The work shall be planned such that the City of Lincoln Traffic Operations personnel are notified 24 hours prior to placing the signal in startup mode. In cases where multiple signals are involved, 24 hours per signal shall be provided.

Requests shall go through the Project Manager. Signal turn-ons shall occur between 8:30 a.m. and 3:00 p.m., Monday through Thursday.

New signalized locations shall be placed in pre-determined flashing operation for a minimum of 4 days, with the exception of new roadways.

E. 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 occur only between the hours of 8:30 a.m. and 3:00 p.m., provided the intersection is controlled by law enforcement personnel. The Contractor shall notify the Lincoln Police Department a minimum of 48 hours prior to the actual requested time to arrange for officer control. This service shall be paid for by the Contractor. The intersection must remain in service at all other times, day or night.

The Contractor shall be responsible for consulting Lincoln Electric System prior to any outages.

24.01 NOT USED

24.02 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. Where portions of the curbs have been constructed and no elevations are shown, the curb grade shall be a straight line between the ends of the existing curbs.

24.02 GRADES (Continued)

The elevation of finished top of pull box shall be established according to conditions numbered 1 - 5 below. The elevation of the top of the pole foundations shall be 1 ½ inches above the grade listed. The cabinet foundation shall be 4 inches above the grade listed.

1. Existing curb and no sidewalk - The grade shall slope upward from the top of the back edge of the curb at the rate of 1:50.

2. Existing curb and 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 and adjoining sidewalk - The grade shall be the same as the grade of the top of the sidewalk.

4. Service road parkway - The grade shall be a straight line between the top of the back edge of one curb to the top of the back edge of the other curb.

5. If lateral grade of the existing roadway exceeds the slope of +/- 1:12, the grade of the finished base will be set by the Engineer. In this case, the Contractor shall also install retaining walls and aprons as directed by the Engineer.

24.03 STANDARDS

Where NEMA Specifications are established, all electrical equipment shall conform to the standards of NEMA (National Electrical Manufacturers Association). In addition to the requirements of these Specifications and the plans, all material and work shall conform to the National Electric Safety Code (NESC); standards of the American Society for Testing and Materials (ASTM); the American Standards Association (ASA); the specifications of the International Municipal Signal Association, Inc. (IMSA); the Insulated Cable Engineers Association (ICEA); the American Institute of Steel Construction (AISC); the American Association of State Highway and Transportation Officials (AASHTO); the Manual on Uniform Traffic Control Devices (MUTCD); and the ordinances of the City of Lincoln, 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.

24.04 MATERIAL TESTS

When any reference is made in the Specifications to any standard specifications, 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 Engineer 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 Engineer 2 copies 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 Engineer.

24.05 MODIFICATION, REMOVAL AND RELOCATION

A. GENERAL

Existing traffic signal and/or street light components or systems shall be modified, removed, or relocated in accordance with the plans and these Specifications. All traffic signal foundations shall be removed. Retained material shall be protected to prevent damage. The cost of damaged materials shall be deducted from the final payment. All traffic signal 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. The excavation remaining after the removal of an item from below grade shall be backfilled in conformance with Chapter 20 of these Specifications.

B. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

1. Removal

Payment for the item shall be made for the measured quantity at the contract unit price bid per each unit for all items. These bid amounts shall be full compensation for removing and disposal of all materials; for all excavation and backfill; and for all labor, equipment, tools, materials, and incidentals necessary to complete the work in accordance with the plans and these Specifications.

2. Relocate, Modify

Payment for the item shall be made for the measured quantity at the contract unit price bid per each unit for all items except cable, which shall be measured by the linear foot. These bid amounts shall be full compensation for relocating and/or modifying materials; delivering and installing all materials; for all backfill; and for all labor, equipment, tools, materials, and incidentals necessary to complete the work in accordance with the plans and these Specifications.

24.06 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 inches in width.

The first four inches 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 inch 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 accordance with the width of the trench. Hand tamping is not permitted. All excess backfill material shall be removed promptly from the site.

24.07 TRACER WIRE SYSTEM

A. GENERAL

The tracing system is comprised of ground rods, locate sticks (when applicable) and tracer wire. This system is used by the locate technician to locate City signal and communication cables.

B. INSTALLATION

1. All electrical system tracers shall have a ground rod installed in the furthest pull box or pole base from the intersection on each leg. A separate tracer wire shall be attached to said ground rod and shall be coiled on the floor of the cabinet. Each pole shall have a separate system tracer attached to the ground lug in the pole and terminated on the safety ground bar in the cabinet.

2. All communication system tracers shall be coiled on the floor in each cabinet. Any fiber pull boxes between intersections shall have a locate stick oriented parallel to the tracer wire, placed 4 feet from the center of the fiber pull box, 2 feet deep, over the fiber conduit. The tracer wire system shall include a ground wire, No 14 THHN, green in color, attached to the center grounding lug of the locate stick and attached to the 10 foot ground rod in the fiber pull box, with a ½ inch conduit between the locate stick and the fiber pull box. The tracer wires shall be attached to the appropriate locate stick lug based on the direction of the tracer wire. For example, tracer wire coming in from the left shall be attached to the left locate stick lug. A jumper shall be attached to appropriate locate stick lugs to complete a continuous tracer wire run.

C. LOCATE STICKS

The contractor shall supply the locate stick, Rhino part TVTI160O B5 or approved equivalent. It shall be a 5 foot x 3 inch triangular flexible orange plastic marker with 5 separate access terminals and set screw to hold terminal concealment cap on. Decals, Rhino part SD-5994C or approved equivalent, shall be placed on all three sides with “Warning, Fiber Optic Cable, City of Lincoln, Before digging in this area call Diggers Hotline 800-331-5666", as shown on LSP 81.

The Contractor shall also provide the ground wire, No 14 THHN, green in color in ½ inch conduit from the locate stick to the fiber pull box ground rod and the ½ inch x 10 foot ground rod. Bend out all three barbs towards the bottom of the stick until the tips touch the post to ensure proper alignment. Place the locate stick in the hole and backfill making sure the barbs stay out and dirt falls on top of them. Properly tamp the soil as the hole is backfilled.

D. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Each locate stick, in place and accepted by the Engineer, shall be measured as a single unit for the item. This price shall be full compensation for the excavation and backfilling required, for furnishing and/or installing the locate stick, for the ½ inch x 10 foot ground rod in the fiber pull box, for the ½ inch conduit and tracer wire from the locate stick to the fiber pull box ground rod; for attaching the tracer wires and tracer ground to the appropriate locate stick lugs and the ground rod; for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

Tracer wire is paid for by the Linear Foot; refer to Section 24.11.

Payment for the ground rod is covered in Section 24.15.

24.08 FOUNDATIONS AND BASES

A. GENERAL

The reinforced concrete or pre-manufactured foundations or bases as required by the project plans shall be constructed and/or installed in accordance with Lincoln Standard Plans.

B. INSTALLATION

Where the foundation or base cannot be constructed as shown on the plans because of an obstruction, the Contractor shall relocate or use other effective methods of supporting the pole, as designated by the Engineer.

An Observer shall be present for the pouring of all traffic signal foundations. 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.

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.

1. Reinforced Concrete

The foundations and bases shall be L3500 concrete, conforming to the requirements of Chapter 11 of the Specifications. Each foundation or base shall be of the shape and dimensions as shown on the plans and shall be poured monolithically.

Forms shall be true to line and grade, firmly braced and secured in place, and 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.

All reinforcement bars for concrete reinforcement shall be 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 A 615, 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 inches of concrete between anchor bolts and steel reinforcing members and the sides and bottom of all foundations and bases. Any reinforcing member not in accordance with the Specification shall be grounds for rejection of the foundation or base by the Engineer.

The bottom of the foundations and bases shall rest securely on firm undisturbed ground.

Anchor bolts which are to be embedded in concrete shall have nuts and threads covered to protect them.

Where required on the plans, formed chamfered corners shall be used. Grinding of concrete to chamfer will not be permitted.

Prior to pole and cabinet installation, anchor bolts and foundation holes shall be barricaded or suitably enclosed to protect the public from possible injury.

Both forms and excavations shall be thoroughly wet before placing concrete.

B. INSTALLATION (Continued)

Concrete shall be vibrated with a high-frequency vibrator after it is placed in the form to eliminate all voids. The top and any exposed portion of the foundation or base shall be troweled smooth, true and level.

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 Engineer, the entire foundation or base shall be removed and a new foundation or base installed. The Contractor shall bear all costs of replacing work deemed unsatisfactory by the Engineer.

2. Power Installed Steel Base

The power installed steel base shall be of the size required by the luminaire mounting height, i.e. 40 foot M.H. street light pole, base length 6.5 feet, conduit entrance 18 inches below anchor base plate, shaft diameter 8 inches and as described on the project plans.

Power installed steel bases shall be used when called for on the plans. The power steel base 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 1:20.

Power installed steel bases shall be installed in accordance with the manufacturer's instructions. The foundation shall be installed with its axis plumb. Cable entrance shall be parallel to the roadway unless indicated otherwise in the plans or directed by the Engineer. 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.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pole or traffic signal cabinet foundations of the size required, complete, in place and accepted by the Engineer, will not be measured for payment separately, but are considered subsidiary to the installation of poles, traffic signal cabinets or pedestals.

24.09 PULL BOXES

A. GENERAL

Pull boxes shall be installed at the locations shown on the plans. The Contractor may install, at the Contractor's expense, any additional pull boxes that may be desired to facilitate the work, as approved by the Engineer.

The Contractor shall keep the edges and lid of the pull box and lifting eye clear of concrete and foreign material.

All pull box lids shall be labeled "ELECTRIC", "TRAFFIC", or "FIBER" as indicted on the Plans.

In the case of the Type PB 3 pull box, cast iron frames and covers shall conform to the plans and the requirements of "Standard Specifications for Gray Iron Casting", ASTM Designation A48, Class 30. Covers shall fit properly in frames and shall not rock. Castings will not be accepted that are warped, cracked, plugged or filled, or that have swells.

24.09 PULL BOXES (Continued)

A. GENERAL (Continued)

1. Pull boxes shall rest firmly on a bed of 3/4 inch washed crushed limestone rock with a minimum depth of 12 inches below the bottom, and extend at least 3 inches beyond the outside edges of the pull box, unless otherwise specified by the Engineer.

2. In the case of the Type PB-6, PB-9, and FOR-27 pull box, the shape and dimensions shall be as shown on the plans. The pull box shall be constructed of epoxy or polyester resin mortar with woven glass fiber reinforcement and an appropriate aggregate. Other material which satisfies the Specifications for structural, physical, and chemical properties may be submitted for acceptance.

   The material shall not support combustion in accordance with “Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position”, ASTM D-635. Water absorption shall not exceed two percent (2%) of the original weight of the material under test conditions, per “Standard Test Method for Water Absorption of Plastics”ASTM D-570. The pull box shall be functional without failure throughout a temperature range of 50 to 170 degrees F.

3. The walls of the pull box Type PB-6, PB-9 or FOR-27 shall not deflect more than 0.024 inches per foot of length of box when installed and subject to an ASTM C-857 TIER 15 load.

B. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pull boxes, complete, in place and accepted by the Engineer, will 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 shall be full compensation for all excavation required; for furnishing and installing the pull box; for conduit, conduit stub out, concrete, and crushed rock; and for all labor, equipment, tools, materials, and incidentals required to complete the work.

24.10 CONDUIT

A. GENERAL

Unless otherwise stated in the plans or Special Provisions, conduit used for cable runs shall be rigid polyvinyl chloride (PVC) conforming to 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 Electrical shall be black/gray.

1. Rigid Polyvinyl Chloride (PVC) Conduit, Schedule 40

   In the case of the heavy-wall rigid polyvinyl chloride conduit, 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 bucklings will not be permitted. Conduit must not be heated to the point of deterioration or damaging the material.

   Where concrete is used to encase conduit, it shall conform to Chapter 17 of these Specifications.

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.

B. INSTALLATION

The routing of conduit as shown in the plans indicates, in most cases, the general location and direction of the conduit runs. If, due to obstructions or certain other field conditions encountered during construction, it is necessary to depart substantially from the routing shown, the Engineer will determine the new location in the field. Conduits terminating in cabinets, poles, or pull boxes shall not be transposed.

Conduits shall terminate as near to the hand hole of poles as possible with the end of the conduit below the lower edge of the hand hole. The last eight inches of the conduit shall be straight and so placed that it is aligned with the hand hole. Conduits shall be secured in their permanent positions during the pouring and curing of the foundation concrete and shall extend three inches above the top of foundations. 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 near the center of the pull box to a point four inches to six inches above the rock. Conduit stub outs shall extend not less than six inches from the outer face of the foundation or pull box, and at the same distance below the top of the foundation or pull box as other conduits in the directions shown on the plans; and shall be capped with standard pipe caps on both ends.

The Contractor shall use 90 degree factory sweeps in controller bases and in fiber pull boxes; in all other cases, the Contractor shall use 90 degree factory bends.

All joints and terminations shall be made in accordance 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.

C. 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 24.06. Conduit shall be installed at a minimum depth of 36 inches, except that conduit designated for “Fiber Optic Cable” shall be installed not less than 42 inches below finished grade, unless otherwise indicated on the plans or by the Engineer.

D. CONDUIT BORED

When shown on the plans or approved by the Engineer, 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 accordance with approved procedures.

Pavement shall not be disturbed without the approval of the Engineer. Upon approval of the Engineer, small test holes may be cut in the pavement to locate obstructions, then filled as per Engineer. Jacking or directional boring shall be kept twenty four inches from the edge of any type of pavement wherever possible. Excessive use of water which might undermine pavement or soften subgrade will not be permitted.

E. CONDUIT SOCK

Conduit Sock is flexible, multi-celled, textile innerduct system designed specifically for pulling additional cables into conduit. Conduit Sock shall be MaxCell MXC 3456 XX (lengh) or approved equivalent placed as per manufacturers requirements.

F. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The installation of conduit stub outs as called for on the plans, including necessary couplings, elbows, and bends shall be considered part of those items for which payment is made and shall not be measured separately.

The quantity of conduit to be paid for shall be the number of feet of such material of the size and type required, installed and accepted by the Engineer as measured from center to center of foundations or pull boxes, or from pole to pole if there is no foundation.

Conduit shall be paid for at the contract unit price bid per linear foot for the conduit items. These prices shall be full compensation for all excavation required; for all concrete, backfilling and compacting; and for all labor, equipment, tools, materials, and incidentals required to complete the work.

24.11 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 will 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. Twisted Pair Communications Cable

   The twisted pair communication cable shall be IMSA Specification No. 59-2 or 60-2, No. 22 AWG as called for on the plans.

3. Lead-In Cable

   Lead-In Cable shall be IMSA Specification No. 50-2, No. 14 AWG.

4. Detector Wire

   Detector wire shall be IMSA Specification No. 51-5, No. 14 AWG.

5. Service, Street Lighting, Circuit Grounding Cable and Pole Grounding Wire

   The cable for underground circuits, namely service street, lighting, circuit grounding, and pole grounding wire shall be single conductor, size specified on the plans, 600V, 75° C, Type USE cable. The insulation shall conform to IPCEA Specification S-66-524. The conductor shall conform to IPCEA Specification S-19-81. Pole ground wire shall be bare No. 6 AWG solid copper.

A. TYPES AND CLASSES OF CABLE (Continued)

6. Fiber Optic Cable

All fiber optic cable shall be new, unused and of current design and manufacture. All fibers in the cable shall be useable fibers and meet the following criteria. Fiber optic cables shall be of the exact number of fibers and type called for on the plans or in the special provisions.

Multi-mode fiber:

Core diameter	62.5 +/- 3.0 – ∫µm
Cladding diameter	125.0 +/- 2.0 µm
Core to cladding offset	<3.0 µm
Coating diameter	250 +/- 15 Graded index µm

Single-mode fiber:

Typical core diameter	8.3 µm
Cladding diameter	125 +/- 1 µm by fiber end measurement
Core-to-cladding offset	<1.0 µm
Coating diameter	250 +/- 15 µm
Attenuation uniformity	No point discontinuity greater than 0.1 dB at either 1310 nm or 1550 nm frequencies. The coating shall be a dual layered UV acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically removable without damaging the fiber.

a. Fiber specification parameters

The attenuation Specification shall be the maximum attenuation for each fiber over the entire operating range of the cable. The change in attenuation at extreme operational temperatures for single-mode fibers shall not be greater than 0.20 dB/km at a wave length of 1550 nm, with 80% of the measured values no greater than 0.1 dB/km at a wave length of 1550 nm.

b. Cable physical properties - Loose Tube

Optical fibers shall be placed inside a loose buffer tube. Each tube shall contain six fibers of the same type. Buffer tubes shall meet EIA/TIA-598, “color coding of fiber optic cables.” Single-mode fibers are to be placed in Buffer #1 (Blue), Buffer #2 (Orange), and Buffer #3 (Green) where composite fiber cable is specified. Multi-mode fibers shall start with Buffer #4 (Brown). Buffer tubes shall be stranded around a central member using the reverse oscillation, or “SC” stranding process.

Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogeneous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.

To prevent buckling of the cable, a central anti-buckling member shall be included in the cable consisting of a glass reinforced plastic rod. Fillers may be added to the cable core to lend symmetry to the cable cross-section where needed. The cable core interstices shall be filled with a water-blocking gel as specified above.

A. TYPES AND CLASSES OF CABLE (Continued)

All dielectric cables with no armoring shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 55 mils.

Jacketing material shall be applied directly over the tensile strength members and gel compound.

b. Cable physical properties - Loose Tube (Continued)

The jacket or sheath shall be marked with the manufacturer's name, the words "Optical Cable", the year of manufacture, and sequential feet marks. The markings shall be repeated every segment. The actual length of the cable shall be within 0 to +1%) of the length marking. The marking shall be in a contrasting color to the cable jacket or sheath. The height of the marking shall be approximately 0.1 inches.

c. Cable Physical Properties - Tight Buffer

Tight buffer may be used if approved by Engineer.

Tight Buffer fiber shall be Optical Cable Corporation, Aerial DX-Series polyethylene distribution cable or approved equal with the appropriate fiber count.

d. Quality assurance provisions

All optical fibers shall be proof tested by the manufacturer at a minimum load of 50,000 psi and 100% attenuation tested. The attenuation of each fiber shall be certified with each cable reel.

7. Tracer Wire

Tracer wire shall be #14 AWG THHN, green in color.

8. Coaxial Cable

Coaxial cable shall be RG 6 Coaxial Cable.

9. Camera Detector Cable

Camera Detector Cable shall be a 5 conductor and RG 59 combination in a single jacket.

The first element consists of 5 conductors each of No. 18 AWG 7/26 copper strand encased in .016 inch thickness of polyethylene, the color code shall be white, red, blue, black, and brown. The second element shall be a RG 59 single conductor, No. 20 AWG solid copper, surrounded by .056 inch foam polyethylene with a 95% bare copper braid encased in a .035 inch black polyethylene. This element shall have an outside diameter of .242 inches.

The overall assembly is housed in a UV stabilized black polyethylene jacket of .030 in thickness.

10. Emergency Detector Cable

Emergency Detector Cable shall be a shielded 3/c with bare ground. The conductors shall be 20 AWG 7/25 BC 600Vac uninsulated. The colors shall be blue, orange, and yellow. The ground shall be 20 AWG 7/26 BC insulated. The outside jacket shall be PVC, black in color, sunlight resistant, and have a total nominal outside diameter of 0.51 inches.

24.11 CABLE (Continued)

A. TYPES AND CLASSES OF CABLE (Continued)

11. Camera Control Cable

Camera Control Cable shall be Type CMX Outdoor - CM 24 AWG CAT5E.

12. Camera Power Cable

Camera Power Cable shall be IMSA Specification No. 19-1, No. 12 AWG to 250 feet or No. 14 AWG to 150 feet , 4/c.

B. INSTALLATION

The installation of power and communications cable shall, in general, conform to the National Electric Safety Code insofar as it applies, subject to the conditions and instruction of the Engineer.

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.

No splices are allowed in any cable except Street Lighting Cable and Circuit Grounding Cable; these cables shall be spliced only when a change in size or split of cables is shown on the plan. Tracer wire may be heat shrink spliced in a pull box.

1. Underground Cable

Prior to installation of underground cable, the Contractor shall insure that the conduit is open, continuous, free of water, and clear of debris.

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 feet 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 feet of extra cable shall be left in the cabinet.

Cables shall be identified by several wraps of colored tape at all access points. Colored tape shall be 3M No 35 or approved equivalent. 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

B. INSTALLATION (Continued)

Metered Cable:

Neutral AC-	Orange	White
AC+ Phase 1	Orange	Blue
AC+ Phase 2	Orange	Blue Blue
AC+ Phase 3	Orange	Blue Blue Blue

6. Fiber Optic Cable - Continued

All other cables shall be identified with SWD-Write-On Tape 054007-11954 3M Electrical or approved equivalent.

Detector Lead-In cables shall be identified with phase and amplifier designation, both in the cabinet and the pull box where the detector is spliced. Traffic signal cables, push button cables, coaxial cables, camera control cables, camera detector cables, camera power cables, emergency detector cables shall be identified in the cabinet with the corresponding pole number. Communication cable shall be identified in the cabinet with the direction of cable from the cabinet.

2. Overhead Cable

The installation of cable shall utilize good line installation practice whereby the cable is pulled in from dead-end to dead-end. Where the overhead cable cannot be connected to the controller terminal or junction box, the Contractor, at their expense, shall provide a temporary dead-end to prevent slacking off of the existing facilities.

All communication and fiber optic cables shall be armored.

Where new cables are installed on an existing pole line, the sag of the new cable shall be the same as existing lines. Clearances shall as a minimum be those of Section 23 National Electric Safety Code, unless a more restrictive position is part of the project plan or "Lincoln Standard Plans." Any deviation from this will require approval of the Engineer prior to final attachment.

A pulling eye and swivel shall be used to eliminate twisting of the cable.

Drip loops shall be provided at all signal hangers, wire inlets, and service entrance heads in conformance with good outdoor wiring methods.

Communication cable and traffic signal cables to isolated lamps shall be identified at each pole attachment by wrapping yellow vinyl plastic electrical tape at least 12 inches on both sides of the attachment using ½ width overlap. The tape shall be permanent and non-fading.

When any portion of the communication cable is installed overhead the following applies:

a. In the communication space, as approved by LES and Telephone, with 40 inches of dead space to the secondary, the communication cable can occupy the riser if the spacing for cables in the run and drip loops is maintained.

b. Without the required minimum space the communication cable shall be installed in a dedicated conduit/riser between the weather-head and the in-ground structure or the pole-mounted traffic control cabinet.

c. All non-communication cables crossing the "communication space" on the structure shall be enclosed in a conduit from the secondary space to the in-ground structure or the pole-mounted traffic control cabinet.

B. INSTALLATION (Continued)

d. The messenger supporting the communication cable shall be bonded to the existing ground systems or new grounds installed. This ground shall be required for all multi-span installations and at intervals not to exceed 1,000 feet.

e. Where the communications cable is to be installed overhead and on poles that are within areas of tree lined boulevards, the Contractor shall:

1. Install a “Pulling-In” line, conforming to the aforementioned sag and attachment.

2. Request the City Arborist to inspect the anticipated tree trimming.

3. Employ the services of a licensed arborist to perform the necessary trimming.

Under no circumstances will trimming of limbs be permitted unless it conforms to the above conditions.

3. Fiber Optic Cable

All fiber optic cable shall be installed in ducts or conduits unless specifically called for otherwise in the Special Provisions. A suitable cable feeding method shall be used between the cable reel and the face of the duct and conduit to protect the cable and guide it into the duct. If pulled by mechanical methods, dynamometers or break away pulling swings shall be used to ensure that the pulling line tension does not exceed 600 pounds. The Engineer must be notified prior to installing cable by mechanical methods. The mechanical stress placed on a cable during installation shall not be such that the cable is twisted or stretched. A pulling eye and swivel shall be attached to the cable and used to pull the cable through the duct and conduit system to prevent the cable from twisting. Cables shall not be forced around sharp corners and precautions shall be taken during installation to prevent the cable from being kinked or crushed. Pulling of the cable shall be hand assisted at each controller cabinet.

As the cable is fed into the duct and conduit system, it shall be lubricated with a water based lubricant approved by the cable manufacturer. The cable shall be carefully inspected for jacket defects. If defects are noticed, the pulling operation shall be stopped immediately and the Engineer notified. The Engineer shall make a determination of acceptability or shall reject the cable.

Sufficient slack shall be left at each end of the cable and tracer wire to allow proper cable termination. Additional slack cable shall be left in each controller cabinet, hand hole, at the top of each conduit riser and at each wood support pole.

The minimum slack amounts shall be as follows:

Controller cabinet pull box - 20 feet
Pull box - 10 feet
Deep or Stacked pull box - 15 feet
Conduit riser - 50 feet

Storage of additional slack cable in controller cabinets and pull boxes shall be coiled. The slack coils shall be bound at a minimum of 3 points around the coil perimeter and supported in their static positions. Storage of additional slack cable adjacent to conduit risers and support poles shall be as detailed on the plans.

Minimum bending radius shall be not less than that recommended by the manufacturer.

B. INSTALLATION (Continued)

The fiber cable shall be installed in continuous runs between cabinets or as marked on the plans. No splices shall be allowed outside the controller cabinets. When splices are authorized in the Special Provisions, only fusion splices shall be allowed

Terminations shall be made using the method recommended by the connector manufacturer. The termination of each fiber at the end-point device shall be by the Contractor.

a. Fiber Termination

All materials shall be temperature rated for -40 C to 80 C or better. The multimode cables shall use ST style connectors. These connectors shall have mated pair insertion loss less than 0.60 dB (0.25 dB typical). They shall have a thermal cycling performance as follows: the change in dB shall be less than or equal to 0.20 dB at -40 C to 80 C. The connectors shall have mating durability less than or equal to 0.25 dB and shall have UL-VO flammability rating. They shall be compliant with ANSI/TIA-568-B.3 and shall fit a panel cut out double-D cut out diameter 0.38 inches. The boot color shall be black.

The single mode cables shall use SC style connectors. They shall have a mated pair insertion loss less than 0.60 dB (0.25 dB typical). The connectors shall have a thermal cycling performance as follows: the change in dB shall be less than or equal to 0.20 dB at -40 C to 80 C. They shall have a mating durability less than or equal to 0.25 dB and shall have a UL-VO flammability rating. The connectors shall be compliant with ANSI/TIA-568-B.3 and shall fit a panel cut out of 1.024 inches by 0.375 inches. The boot color shall be yellow.

The breakout panels shall be either wall mount or rack mount and shall be of a metal construction. They shall have a door on the installer side. The cable entry ports shall be aligned on the top and bottom to allow stackable mounting. The break out panels shall be equipped with the proper number and style of feed through needed at the installed location. They shall be equipped with all hardware necessary to route the fibers and secure cables. It shall insure fiber bend radius protection.

All splices shall be fusion. The fusion splices shall meet or exceed industry standards. They shall have fusion splice protection sleeves. The splices shall be installed in splice trays. The trays shall be stackable. All trays shall be housed in either a wall mount or rack mount cabinet, which shall be metal. Cable entry ports shall be aligned on top and bottom to allow stackable mounting. They shall be equipped with all hardware necessary to route the fibers and secure cables. It shall insure fiber bend radius protection.

b. OTDR Testing

An Optical Time Domain Reflectometer (OTDR) shall be used to evaluate the quality and length of cable reels prior to their use on the project. The fiber loss in dB/Km and the length of each reel shall be recorded in the documentation. The maximum attenuation of the cable shall be 3.5 dB/km nominal, measured at room temperature at a wave length of 850 nm. The OTDR shall be rated at 850 nm, 1310 nm, and 1550 nm light wavelengths.

A hard copy of OTDR signature traces for all system links shall be made and provided in the documentation.

LED light source(s) with the wavelengths that are part of the system wavelength shall be used. The LED shall be stable within 0.1 dB in intensity over a time period sufficiently long to perform the measurement. The output of the LED shall overfill the input end of the launch fiber/cable in both numerical aperture (NA) and core diameter. Light source(s) shall be provided for 850 nm, 1300 nm, 1310 nm, and 1550 nm wavelengths.

B. INSTALLATION (Continued)

The detector in the power meter shall have an effective numerical aperture and active region that is larger than the receive reference cable and/or the fiber under test. The power meter shall have a minimum range from +3 dB to -40 dBm. The power meter shall have an accuracy of +/- 0.5 dB through the operating temperature and minimum resolution of 0.1 dB. The power meter shall properly read wavelengths of 850 nm, 1300 nm, 1310 nm and 1550 nm.

The launch cable shall provide the attachment of the power meter. The receive cable fiber shall be of the same fiber core size as the fiber under test.

c. Attenuation Documentation

The end to end attenuation shall be measured for each link after installation by insertion loss testing.

The launch reference cable shall be connected to the light source and the receive reference cable to the power meter. The two reference cables shall then be connected via a patch panel. A reference power reading (P1) shall then be taken and recorded.

The system link to be tested shall then be inserted between the launch and receive reference cables using 2 patch panels. A test power reading (P2) shall then be taken and recorded.

The link attenuation (A) in decibels (dB) shall be calculated and recorded as the mathematical difference between the reference power (P1) reading and the test power (P2) reading:

A= P1-P2 where:
P1 = reference power reading, and
P2 = test power reading

This test shall be performed in both directions along the link. The direction of the test shall also be recorded in the documentation.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The quantity of electrical cables and/or conductors to be paid for shall be the number of feet of such material of the size and type required, installed and accepted by the Engineer, as measured from center to center of foundations or pull boxes, or from pole to pole if there is no foundation.

Cable inside foundations, poles, pull boxes, cabinets, and other such devices or structures shall be subsidiary to those items and will not be measured for payment.

No measurement or direct payment shall be made for loop wire or pole wire, but shall be considered part of the vehicle detector and pole items, respectively.

Electrical cable, communication cable and/or conductors shall be paid for at the contract unit price bid per linear foot for the items. These prices shall be full compensation for all excavation required for backfilling and compaction; and for all labor, equipment, tools, materials, and incidentals required to complete the work.

Fiber optic cable shall be measured and paid for at the Contract unit price bid per linear foot for the type, size, and number of fibers specified. Such price shall be full compensation for furnishing and installing fiber optical cable, all necessary slack, testing, documentation, termination, and all other materials, hardware, labor, equipment, tools, and incidentals necessary to complete the work.

24.12 CABLE SPLICES AND CONNECTIONS

A. GENERAL

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. No bare wire shall be exposed.

Service connections to the Traffic Signal Control Cabinet shall be continuous from the power source.

B. TWISTED PAIR COMMUNICATIONS CABLE SPLICES

All splicing of Twisted Pair Communication Cable shall be by City personnel.

C. CABLE SPLICES AND CONNECTIONS FOR ALL CABLES EXCEPT TWISTED PAIR COMMUNICATIONS CABLE.

1. Heat Shrink Splices

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 degrees to +130 degrees 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 degrees F. Scorched or burned splice components and/or sheathing will not be accepted.

C. CABLE SPLICES AND CONNECTIONS FOR ALL CABLES EXCEPT TWISTED PAIR COMMUNICATIONS CABLE. (Continued)

2. Split-Bolt Connections

This splice shall consist of a mechanically and electrically sound split-bolt connection encapsulated in a permanent seal, waterproofing and insulating the electrical connection.

Splice connectors shall be a bronze, compression bolt-type. Connectors of the proper size to fit the largest conductor in the connection shall be used to join wires in pull boxes. Split-bolt connectors shall be used only to connect tap wires to service cable, circuit ground and "in run" street light cables for No. 4 AWG or larger. When making connections to No. 2 AWG wires or larger, the connectors used shall be two-bolt type. 2 wrenches shall be used to tighten split-bolt connectors.

All bolt-type connectors shall be wrapped in one layer of tissue before the application of the electrical insulation putty, and then the thermoplastic electrical insulation tape. The insulation tape shall be covered with ½ width lapped layer of thermoplastic electrical insulation tape extended past the rubber insulation. Splices shall be finished with an application of asphaltic impregnated open mesh fabric tape or coated with a waterproof compound.

3. Block Connectors

Street Light connectors to be used in poles shall be a 3 hole connector with clear cover Burndy No. BIBS-4-3 or CMC No. NACC or approved equivalent.

4. 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 Gelcap-SL-2\0-3 hole or approved equivalent 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 with No. 6 AWG or smaller wires.

5. 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 Raychem Gemwrap 18\4-200 or approved equivalent 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.

D. SECONDARY FUSES AND FUSE HOLDERS

Secondary fuses for single luminaire circuits or in street light poles shall be Buss-Type KTK, 10 ampere or equal. Secondary fuses for multiple luminaire circuits shall be Buss-Type KTK, 30 ampere, breaker or relay. Fuse holders shall be Buss-type HEB or equal.

E. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

No measurement or direct payment shall be made for cable connections, splices, attachments, materials and incidentals necessary to complete the work in accordance with the plans and Specifications. The work shall be considered subsidiary to and included in the bid price for cable installation.

24.13 TRAFFIC SIGNAL, LIGHTING OR TRAFFIC MONITORING POLE

A. GENERAL

The Material Specifications are found on the Lincoln Standard Plans (LSP) made part of this specification by reference and available as a separate document.

B. INSTALLATION

Poles and/or pedestals are to be installed at the locations shown on the plans, unless permission to change the locations is given by the Engineer. The access door of the transformer base, the hand hole and festoon outlet shall be located on the side opposite the street unless otherwise indicated on the plans. Poles shall be placed so that modifications and/or attachments are carefully oriented, as indicated on the plans.

The concrete foundations must be given 72 hours to cure before the pole shafts are erected. Concrete foundations must be given 7 days to cure or until concrete reaches its specified strength before any loads other than the pole shaft are applied. The center of the pole is to be set back from the back of curb the distance shown on the plans.

Poles must be erected so that they are plumb with traffic signal heads, pedestrian signal heads, and required street light luminaires installed. 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 bare copper ground wire shall be installed so that the shaft portion of the pole is connected electrically to the ground rod 2 feet from the pole foundation. When transformer bases are used, the pole shaft portion and the transformer base section shall be bonded to the bare copper ground wire, and the combination must be connected to the foundation ground rod.

Embedded steel poles shall be backfilled with a high density modified polyurethane foam. The Contractor shall coat the entire vertical pole butt surface with foam from base 1 foot below ground line. The poles shall be masked to 1 foot below the ground line to prevent splattering and provide a uniform edge.

All holes for poles shall be drilled or augered. 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 6" nor less than 2". Depths of holes shall be determined by embedment length requirements of the pole, but shall in no case be less than 4'.

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 six inch (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 ½" sieve	90-100%

A ground rod shall be set in undisturbed earth 24 inches from the outside edge of the augered pole with the top of the ground rod 12 inches below grade. A continuous ground wire shall connect the ground rod to the grounding lug on the pole.

Handholes shall be oriented so that they are opposite the direction of vehicle traffic on the side of the road at which the pole is installed.

Nylon slings shall be used to handle all poles to prevent damage to the paint. All poles shall be left clean after erection, and damaged paint shall be sanded and repainted.

A small section of 1" 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 poly 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 Observer. The age of the polyurethane 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 that 4.2 pounds per cubic foot and shall have a sheer strength not less than 38 p.s.i. and shall have a compressive strength not less than 75 p.s.i.

The foam shall be tested when required by the Engineer in accordance with ASTM D 2856/ANSI K 65.152; ASTM D 1623/ANSI K65.32; and ASTM D 1621/ANSI K65.31.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Poles of the various types and sizes, complete, in place, and accepted by the Engineer, shall be measured for payment as single units. Payment shall be made at the contract unit price bid for the items.

This price shall be full compensation for all excavation, for furnishing and/or installing the pole, mast arm, luminaires and lamps, photo control or shorting cap, cable, conductors, span wire, tie wire, concrete, conduit stub-out, reinforcing steel, anchor bolts and anchor bolt covers, power installed foundations, transformer base, breakaway base or for the placement of the high density modified polyurethane foam, ground rods, and for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

24.14 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 inches. When earth fill is specified, earth around the hole shall be tamped solid, and to the satisfaction of the Engineer. 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 earthfill, shall be as specified in the Special Provisions.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Each wood pole, in place and accepted by the Engineer, shall be measured as a single unit 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, service riser, meter socket as required; for ground rod and ground wire connections; and for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

24.15 GROUND RODS AND GROUND WIRE

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 full length as shown on the plans, 2 feet from the pole base, and oriented on the same side as the hand hole or in a pull box; they shall have a nominal diameter of ½ inch and be 10 feet in length. 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 need 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 shall be firmly connected to the traffic signal cabinet ground rod provided by means of the grounding terminal specified in Article 24.13 of these Specifications. 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 shall be connected between the traffic signal cabinet and the ground rod using a circuit grounding conductor of the size required on the plans.

Ground rods and ground wires shall be installed with wood poles when specified on the plans. The ground wire shall be stapled to the side of the wood pole every 10 feet and shall be covered with a wood molding from the ground level to a point 6 inches below the top pole attachment. The top of the ground rod shall be 12 inches below grade.

24.15 GROUND RODS AND GROUND WIRE (Continued)

Where called for on the plans, ground rods and wire shall be installed to ground the communications cable messenger. This installation shall consist of a ground rod ten feet in length, approximately twenty three feet of ground wire, and other materials necessary to meet this Specification.

Overhead messenger cable used for suspension of cables and/or signal displays installed with down guys shall have the messenger and down guy bonded and grounded.

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.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

No measurement or direct payment will be made for ground rods, ground wire, messenger ground, attachments to existing ground, or grounding clamps installed in conjunction with wood or steel poles, pedestals, or pull box nearest traffic signal cabinet. Ground rods and ground wire shall be considered subsidiary to and included in the bid price for the several items for which direct payment is made. In the case where ground rod is at the end of a tracer run, the ground rod shall be paid for as a single unit.

24.16 SIGNAL SUPPORT SPAN

A. GENERAL

Span wire shall be 3/8 inch, 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 inch 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.

B. INSTALLATION

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 be 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.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The installation of the signal support span will not be measured separately but shall be considered subsidiary to, and included in, the bid price for other items. Span wire, tie wire, pole clamps, cable clamps, and miscellaneous line hardware are considered part of the signal support span.

24.17 DOWN GUY AND OVERHEAD GUY

A. GENERAL

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 eight-inch minimum diameter and using a 7 foot by 5/8 inch 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 feet in length.

Down guys shall not enter the ground less than 24 inches from the edge of the sidewalk unless otherwise shown on the plans.

B. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Down guy or overhead guy, in place and accepted by the Engineer, shall not be measured separately, but will be subsidiary to other items of payment. This shall include necessary ground anchor, guy wire, guy guard, and line hardware.

24.18 VEHICLE DETECTOR INSTALLATION

A. GENERAL

Vehicle detectors shall be either inductance loops, magnetic probes, or overhead detection as called for on the plans. All loop and magnetic probe locations shall be marked on the pavement by the Contractor prior to installation and approved by the Engineer. The Contractor shall review the installation drawing prior to scheduling its operations, so as to expedite the installation process and cause a minimum of traffic interference. The Contractor shall adhere to the specified detector locations. A loop should never be relocated laterally; its relationship to the lane centerline must be kept as shown on the plans. If some unforeseen condition necessitates repositioning a loop, the change must be approved by the Engineer.

B. LOOP DETECTORS

The installation of vehicle detector loops are described as either sawed-in or preformed. Sawed-in loops are placed in existing roadways in a 3/8 inch wide slot. Under cover loops may be placed in or on the subgrade prior to placing the surface, placed in a wheel sawed slot, or placed beneath surfacing material, as shown on the plans. All loops shall be 6 feet by 6 feet and have number of turns as specified on the plans.

1. Sawed-in-Loop

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 degrees F and rising, unless otherwise approved by the Engineer. 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 inch width. The depth of the saw cut shall be 3 inches. 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.

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.

c. Wire Installation

Loop wire shall go directly from the loop to a pull box. IMSA 51-5 No. 14 AWG wire shall be used. The wire shall be a continuous length, no splicing allowed. The wire brought to the pull box shall be clearly tagged, identifying the loop number. 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 inches. The backer rod shall be of sufficient number and size to hold the wire in place while the sealant cures and resilient over the temperature range of -40 degrees to +160 degrees F. The top of the backer rod shall be at least 1 ½ inches beneath the surface of the pavement.

d. Sealing the Saw Cut

The sealant used to cover the wires in the slots shall be an elastic epoxy resin compound approved by the Engineer. The epoxy shall have a tack-free curing time of not more than one and 1 ½ hours at 75 degrees 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 roadway 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. UC (Under cover) Loop

The Contractor shall furnish and install under cover loop detectors at a depth of a minimum of 1 inch to 6 inches under new pavement or placed in a wheel-sawed slot in the base prior to placement of resurfacing material. Care should be taken to prevent damage to the loop and lead in before and during the paving operation.

The under cover loop may be formed to be rigid or flexible, with the number of 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.

3. Loop Acceptance

Each loop shall be tested at the cabinet by the 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. MAGNETIC DETECTORS

The magnetic detector installation shall include the furnishing and installing of a Pull Box, type PB-9 deep or stacked Pull Boxes, type PB-9, a 3 inch PVC conduit of the length specified on the plans, beneath the roadway and within the foundation material, if any, and the installation of a City furnished magnetic probe complete with the wire leads spliced to the 2/c traffic signal cable, that connects to the signal cabinet.

The Contractor shall install the magnetic probe for multi-lane approaches under the lane line between two adjacent lanes. Magnetic detectors installed under one approach lane shall be installed in the center of the lane.

24.18 VEHICLE DETECTOR INSTALLATION (Continued)

D. OVERHEAD DETECTION

1. Video Detection

The video 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 Section 24.19, and a 5 foot rigid aluminum conduit extension, placed above the arm. The Contractor shall aim and adjust the camera under the supervision of City personnel.

2. Emergency Detection

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. The clamp kit shall be Pelco part number AB-0132-29 or approved equivalent.

E. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Vehicle detectors, complete, in place, tested, and accepted by the Engineer, shall be measured for payment as single units. Payment shall be made at the contract unit price bid per each for the vehicle detector item. In addition, vehicle detector loops sawed in place or under cover loops placed shall be tested and approved prior to any payment for the traffic signal cabinet.

This price and payment shall be full compensation for the furnishing and installing the under cover loops or the magnetic detector (City furnishes the probe) and for furnishing and installing sawed-in loops, including epoxy, and sawing (slot or wheel), clamp kits, rigid aluminum conduit, pull-box(es) (stacked) as required with the magnetic detectors, conduit as specified, loop wire, and for all labor, equipment, tools, testing, materials, and incidentals required to complete the work.

24.19 SIGNAL HEADS AND METRO STREET NAME SIGNS

A. GENERAL

Traffic Signal, Pedestrian Signal Heads, LED Signs, and Metro Street Name Signs complete with clamps and hardware are 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.

The clamp kit shall be Pelco, part number AS-3009-(L) or approved equivalent. The (L) corresponds to the length of cable needed. 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 be made of high tensile aluminum alloy.

The clamp kit shall have two sides with 1 ½ inch 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

Signal heads and LED signs shall be installed as shown in the plans to the approval of the Engineer. All traffic signal head locations shall be marked on the pavement by the Contractor prior to installation and approved by the Engineer. 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.

Down nipple extension 1 ½ inches 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 Lincoln Standard Plans.

If, after the signal assemblies are erected and the road 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 traffic signal heads. Burlap, cardboard, or plastic 'trash style' bags shall not be accepted. All signal covers shall be approved by the Engineer prior to use. No inoperative signals on a road which is open to the public shall be left uncovered under any circumstances.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Traffic and pedestrian signal heads and LED signs installed, connected and accepted by the Engineer, will be measured for payment as single units. The furnishing and installing 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.

Traffic and pedestrian signals, and LED signs of the various types shall be paid for at the contract unit price bid per each item. These prices shall be full compensation for installing the traffic signal head, pedestrian signal head, all lamps, LEDs, back plates, mast arm and shaft clamp kits, nipples, stainless-steel banding, pipe fittings, for all pole and mast arm modifications; and for all painting, labor, equipment, tools, materials, and incidentals necessary to complete the work.

24.20 RISER

A. GENERAL

A riser is a conduit vertically attached to a pole or a building used to hold cable. Unless otherwise stated in the plans the riser shall be galvanized rigid steel conforming to the Underwriters Laboratories “Standard for Safety” UL-6 and rigid polyvinyl chloride (PVC), Schedule 40, conforming to UL “Standard for Safety: UL-651.

B. INSTALLATION

All risers shall be schedule 40 PVC and shall be of the size specified in the plans and shall be installed at the location shown on the plans. The bottom 10' of the riser shall be rigid galvanized steel. Risers mounted on the sides of building shall be located as close to any existing underground network riser as is practical in a manner acceptable to the Engineer. The steel portion of the conduit riser shall be grounded at the top.

All pole risers shall be on stand off brackets provided by LES. These can be picked up at the LES store room. See LSP 83 for spacing detail.

The bottom 3 feet of service risers installed on buildings shall be encased in concrete not less than 3 inches in thickness. Concrete shall be L3500 conforming to the requirements of Chapter 11 of these Specifications.

When required in the plans, the Contractor shall furnish the riser with the meter socket.

The Lincoln Electric System will furnish and install the meter. The Lincoln Electric System will connect the electric service to the power supply cables at the top of the service riser.

24.20 RISER (Continued)

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Riser, complete, in place and accepted by the Engineer, will 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 shall be full compensation for all excavation required; for furnishing and installing the riser; for conduit pipe clamps, ground wire, ground rod, concrete encasement, steel riser guards, meter socket, and incidentals are considered part of the riser assembly.

24.21 CABINETS

A. GENERAL

This section refers to traffic signal cabinets, Type B, C, and F and climate control cabinets.

Upon completion of the work, each traffic signal cabinet or climate control cabinet shall be properly placed, mounted, wired, and connected to operate as shown on the cabinet prints provided by the City.

Unless otherwise noted, the traffic signal 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 traffic signal cabinet, base, and concrete pad as shown on the plans in accordance with the Lincoln Standard Plans. Type B, C, or F cabinet shall have a 4 foot by 6 foot by 4 inch concrete pad in front of the door.

The Contractor shall connect all signal heads, pedestrian push buttons, vehicle detectors, grounds, tracer wire, service cable, 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 traffic signal cabinet and shall be clearly identified with pole number or detector number using SWD-Write-On Tape 054007-11954 3M Electrical or approved equivalent.

The Contractor shall work closely with the Engineer in scheduling traffic signal cabinet installations so as to minimize intersection down time.

All wiring for the control cabinet shall be completed by the Contractor using a wiring diagram furnished by the City.

The Contractor shall mount the control cabinet on the backside of the signal cabinet or on the pole with the top at 6 feet above the ground. Care shall be exercised when drilling holes in the cabinet so as not to damage any of the equipment or wiring housed inside. Any damage that occurs shall be repaired at the Contractor's expense. If the Contractor is unable to repair said damage, then the cost shall be deducted from the final payment. Once the control cabinet is secured to the signal cabinet, the Contractor shall connect the two cabinets using two non-metallic liquidtite conduits. One shall be 1 ½ inch in diameter for all camera cables, the second shall be 1 inch in diameter to supply power to the control cabinet. These conduits and all ends shall be furnished by the Contractor.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Each traffic signal cabinet, installed, connected, tested and accepted by the Engineer, will be measured as a single unit and shall be paid for at the contract unit price bid for the item.

This price and payment shall be full compensation for installing the traffic signal cabinet, concrete pad, base, all connections, reinforcing steel, concrete, ground rod, pole mounting hardware, and for all labor, equipment, tools, materials, excavation, and incidentals required to complete the work.

24.22 PEDESTRIAN PUSH BUTTON

A. GENERAL

Unless otherwise noted, the pedestrian push button assembly will be furnished to the Contractor by the City. Each pedestrian push button shall consist of push button assembly, instruction sign, frame, and necessary mounting screws.

B. INSTALLATION

Pedestrian push buttons shall be mounted on the correct pole face as shown on the plans, and shall be at the height shown on the Lincoln Standard Plans. All push buttons shall be marked by the Contractor and approved by the Engineer prior to installation.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pedestrian push buttons, complete, in place and accepted by the Engineer, will be measured for payment as single units, and shall be paid for at the contract unit price bid per each item.

This price and payment shall be full compensation for installing and connecting the pedestrian push button, the instruction sign, and the push button frame; and for all labor, equipment, tools, materials, and incidentals necessary to complete the work.

24.23 ROADWAY LIGHTING, LUMINAIRES AND LAMPS

A. GENERAL

The luminaire and components shall have been designed for roadway lighting and shall conform to all the applicable requirements of the National Electrical Safety Code.

B. MATERIAL AND DESIGN

1. General

The roadway luminaires shall be similar in appearance to the ‘cobra head’ type luminaire. The following 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 inch 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.

The luminaire shall include a EEI-NEMA Standard 3 terminal, twist lock type photo electrical control receptacle. The receptacle shall be an integral part of the luminaire and shall be gasketed.

The lens glass shall be held securely in the lower body with a combination of permanent and removable lugs. The positioning of the lugs shall allow for expansion of the lens but will seat the lens securely enough to prevent the lens from accidentally coming out of the lower body in either the open or closed position.

A one-piece reflector shall be mounted in the upper housing with spring fasteners and shall securely seat on the lens rim, with gasket in place with the luminaire closed. A gasket shall be fixed to either the reflector or the lens to insure sealing of the optical chamber. The gasket shall be designed to be used for the lifetime of the luminaire but shall be attached in such manner that it may be replaced in the field should necessity occur. The gasket shall be constructed of either an ethyl propylene terpolymer or a polyester material. When the gasketing material is ethyl propylene terpolymer, a supplemental filtering system shall be incorporated into the optical chamber to insure the proper breathing of the optical system.

3. Optical System

The socket shall be porcelain enclosed mogul screw base socket with a spring loaded center contact and lamp grips.

The socket housing shall be securely seated into the optical chamber using a heat resistant gasket between the reflector and the socket as well as positive mechanical means to insure the sealing.

The reflector shall be constructed from lighting sheet type aluminum. The finish shall be “Alzak” or equal. The oxide coating of the finish shall be no less than 0.13 ounces per square foot and shall be 99.9% pure aluminum. The reflecting surface shall not char, burn, nor give off fumes when heated to 300 to 390 degrees F. The heat transfer coefficient shall be equal to that of “Alzak” finished reflector sheet.

The finish shall be impervious to dust and dirt in a normal environment. Periodic cleaning with a soap and water solution shall neither damage nor reduce the reflectivity of the finish.

The finish shall be highly specular and shall have minimum reflectivity of 82% throughout the visible portion of the electromagnetic spectrum. The reflector shall have transmittance of at least 80%; and a refractive index of 1.474-1.488 at two feet.

The lens glass shall be flat and shall be constructed of heat resistant, thermal, shock treated, clear borosilicate glass.

The following characteristics of borosilicate glass (tempered) apply:

1) coefficient of thermal expansion per degree C 34-52 x 10^{-7}.
2) from 0-300 degrees, cm/cm degree Celsius
3) upper working temperatures degree Celsius (mechanical considerations only)
4) tempered-normal service type glass 250º - 260º Celsius.
5) thermal shock resistance (Plates 6 x 6 x 1/4 inches) based on plunging samples into cold water after oven heating.
6) resistance of 100º C means no breakage if heated to 110º C and plunged into water at 10º C.
7) allowable range 100º-150º C.
8) impact abrasion resistance (relative resistance to sand blasting) 3.1-3.2.

All ballast components shall be mounted on a metal plate easily accessible for in-place maintenance or removal when the luminaire is open. The ballast shall, when in position, be an integral part of the luminaire and shall be electrically connected to the luminaire with quick disconnect plugs.

All electrical components and connections shall have been pre-wired at the factory so the luminaire is ready for immediate installation.

4. 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 66º-75º (degrees projected angles above nadir).

5. Electronic Photoelectric Controls

A. General

1. 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	100 Watt Tungsten 1800 VA Ballast
3.	Contact Rated Life	5000 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	160 Minimum

F. Housing and Markings

1.	Color	Blue
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, Model, Ratings & Installation Date Provisions
6.	Cover Markings	Manufacturer's Logo & Year of Manufacture
7.	Cover/Base/Receptacle Seal	Cross-Linked Polyethylene Gasket
8.	Plug Blades	Brass, Three 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	4 Years
2.	Replacement	One for One

Approved manufacturers and catalog numbers are:

Dark to Light (DTL)	DP124-1.5PTW
Area Lighting Research (ALR)	2090-VPS
Sun-Tech	PX124-1.5PTW

6. Electrical Requirements

Lamp 150 watt HPSV Ballast Type Constant Wattage

Line Voltage	240 Volts
% Allowable Voltage Variation	+10%
Wattage Regulation	Per ANSI%
Lumen Regulation	Per ANSI%
Line Watts (Max.)	195 Watts
Lamp Current Crest Factor (Max.)	1.8
Power Factor	90+%
% Allowable line voltage DIP	10-35%
Open-Circuit Volt (min)	110 Volts
Line Operating current	1.0 Amps
Line Starting current	0.6 Amps
BIL Rating	5 KV

Plug-in Starting Aid requirement for HPSV Lamps

Pulse Peak Voltage (min.)	2500 RMS
Pulse Peak Voltage (max.)	4000 RMS
Pulse Width	1 Micro sec. (min.) at 2250 Volts
Pulse Repetition	50 per sec. (min.)
Pulse Peak Current	0.2 Amp (min.)

7. Electrical Requirements

Lamp 250 watt HPSV Ballast Type Constant Wattage

Line Voltage	240 Volts
% Allowable Voltage Variation	+10%
Wattage Regulation	Per ANSI%
Lumen Regulation	Per ANSI%
Line Watts (Max.)	310 Watts
Lamp Current Crest Factor (Max.)	1.8
Power Factor	90+%
% Allowable line voltage DIP	10-35%
Open-Circuit Volt (min)	195 Volts
Line Operating current	219 Volts
Line Starting current	0.9 Amps
BIL Rating	5 KV

Plug-in Starting Aid requirement for HPSV Lamps

Pulse Peak Voltage (min.)	2500 RMS
Pulse Peak Voltage (max.)	4000 RMS
Pulse Width	1 Micro sec. (min.) at 2250 Volts
Pulse Repetition	50 per sec. (min.)
Pulse Peak Current	0.2 Amp (min.)

24.23 ROADWAY LIGHTING, LUMINAIRES AND LAMPS (Continued)

8. Electrical Requirements

Lamp 400 watt HPSV Ballast Type Constant Wattage

Line Voltage	240 Volts
% Allowable Voltage Variation	+10%
Wattage Regulation	Per ANSI%
Lumen Regulation	Per ANSI%
Line Watts (Max.)	482 Watts
Lamp Current Crest Factor (Max.)	1.8
Power Factor	90+%
% Allowable line voltage DIP	10-35%
Open-Circuit Volt (min)	195 Volts
Line Operating current	2.0 Amps
Line Starting current	1.3 Amps
BIL Rating	5 KV

Plug-in Starting Aid requirement for HPSV Lamps

Pulse Peak Voltage (min.)	2500 RMS
Pulse Peak Voltage (max.)	4000 RMS
Pulse Width	1 Micro sec. (min.) at 2250 Volts
Pulse Repetition	50 per sec. (min.)
Pulse Peak Current	0.2 Amp (min.)

C. INSTALLATION

The position of the lamp socket in each luminaire must be adjusted in accordance with the manufacturer's specifications to provide the I.E.S. type distribution pattern required by the plans.

Unless otherwise indicated in the plans or directed by the Engineer, luminaires will be installed level in both horizontal axes.

Each completed street light circuit shall have a 72 hour burn test prior to acceptance.

D. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Luminaires of the type and wattage required by the plans, complete, in place and accepted by the Engineer, shall not be measured for payment separately, but are considered subsidiary to the installation of poles.

24.24 TEMPORARY TRAFFIC SIGNAL

A. GENERAL

Temporary traffic signal systems shall be installed as called for on the plans. The City will furnish the Contractor with traffic signal and pedestrian signal heads, traffic signal cabinet, emergency devices, detector connections, luminaires, video detection, magnetic probe, and pedestrian push button 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.

24.24 TEMPORARY TRAFFIC SIGNAL (Continued)

The Contractor shall make arrangements with Lincoln Electric System for power service for the temporary signals. Any delay resulting from a Contractors untimely request to the Utility for temporary power service shall not be justification for the suspension or adjustment of the working days or calendar days on a project. The Contractor shall be responsible for the utility costs to install or relocate the power service.

When the work is complete, 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. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The complete temporary traffic signal system 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 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.

24.25 SUBSTANTIAL COMPLETION

The traffic signal and/or street lighting portion of projects 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 Engineer. The system shall be fully operational in accordance with the Plans and Specifications.

Liquidated damages shall continue to accrue until such time as the work is deemed to be substantially completed by the Engineer. However, the Contractor may submit a written request to the Engineer 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 Engineer shall not relieve the Contractor of responsibilities for the completion of those items for which the suspension is requested.

24.26 DYNAMIC MESSAGE SIGNS

A. GENERAL

Dynamic Message Signs shall be installed as shown on plans. The City will furnish the following dynamic message sign and wire of sufficient length to reach the pole mounted control cabinet. All other materials, such as, but not limited to, four clamp kits unless otherwise stated (as specified in Section 24.19), all necessary plumbing to go from City supplied flange to cabinet (i.e. nipples, LB's, locknuts, etc.), shall be furnished and installed by the Contractor, unless otherwise noted.

B. INSTALLATION

The dynamic message sign is pre-wired with the appropriate wires. The Contractor is responsible for mounting the sign and the control cabinet. The top of the control cabinet shall measure six feet from the ground. The Contractor shall bring the wires from the dynamic message sign into the control cabinet. The Contractor is responsible for bringing power into the cabinet and termination of all wiring.

24.26 DYNAMIC MESSAGE SIGNS (Continued)

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Installation of the dynamic message sign 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 all materials not furnished by the City, installing all materials, and for all labor, equipment, tools, materials, excavation, and incidentals required to complete the work.

24.27 TRAFFIC MONITORING CAMERAS

A. GENERAL

Traffic monitoring cameras shall be installed as shown on plans. The City of Lincoln will furnish the following materials: camera and dome. The Contractor is responsible for the clamp kit (as specified in Section 24.19). All other materials shall be furnished and installed by the Contractor, unless otherwise noted.

B. INSTALLATION

The clamp kit shall attach the camera assembly to the designated pole, as shown on plans. The camera shall be attached at the top of the pole, pointing to the opposite corner of the intersection unless otherwise instructed.

Wiring the camera shall be completed by the Contractor.

C. METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Installation of the traffic monitoring camera 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 all materials not furnished by the City, installing all materials, and for all labor, equipment, tools, materials, and incidentals required to complete the work.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 25

ORNAMENTAL STREET LIGHTING

ARTICLE	TITLE
25.00	General
25.01	Related Items Specified Elsewhere
25.02	Electrical Conduit
25.03	Electrical Connectors
	A. Connectors Used in Subsurface Applications B. Connectors Used in Poles
25.04	Secondary Fuses and Fuse Holders
25.05	Ground Rods
25.06	Poles
	A. Embedded Steel Poles B. Embedded Fiberglass Poles
25.07	Luminaires
25.08	Lamps
25.09	Electrical Cable
25.10	Photoelectrical Controls
25.11	Ferrous Hardware
25.12	Pull Boxes
25.13	Grades
25.14	Trenching and Backfilling
25.15	Restoring Street Surfaces and Concrete Work
25.16	Installation of Poles
	A. Embedded Steel or Aluminum Poles B. Fiberglass Poles
25.17	Installation of Luminaires

ARTICLE	TITLE
25.18	Installation of Cable and Conduit
25.19	Installation of Photoelectric Controls and Lamps
25.20	Power Supply and Riser
25.21	Tree Trimming
25.22	Secondary Connections
25.23	Removing and Resetting of Mailboxes
25.24	Method of Measurement and Basis of Payment

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 accordance with the plans and these 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 the System Control Department 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 accordance with the plans and these 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 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 Specifications. Wherever manufacturer's catalogue numbers are used, that specific item is to be used unless approved equal material or other manufacturer's material is specifically authorized by the Engineer. The word "approved" means acceptable by the Engineer.

Before ordering any material, the Contractor shall submit to the Engineer for approval three (3) or more copies of the manufacturer's specifications and drawings for all of the equipment and materials indicated below. The City shall not be liable for any equipment or materials ordered or purchased by the Contractor prior to approval.

Paint
Poles
Luminaires and Lamps
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

25.00 GENERAL (Continued)

The manufacturer's specifications and drawings shall include the brand name, any identifying numbers, required technical data, and any other information necessary for the Engineer's review and for procuring exact replacements of any and all equipment and material used on this project.

25.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 20 Construction for Utilities and Structures
Chapter 24 Traffic Signals and Street Lighting

25.02 ELECTRICAL CONDUIT

Electrical conduit shall be of the size and type shown on the plans. Quality and installation of electrical conduit shall be in accordance with Article 24.10 of these Specifications.

25.03 ELECTRICAL CONNECTORS

See Section 24.19.C of these Specifications.

25.04 SECONDARY FUSES AND FUSE HOLDERS

Secondary fuses for single luminaire circuits or in street light poles shall be Buss-Type KTK, 10 ampere or equal. Secondary fuses for multiple luminaire circuits shall be Buss-Type KTK, 30 ampere. Fuse holders shall be Buss-type HEB.

25.05 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 one-half inch (½") in diameter and ten feet (10') in length. Ground rods shall be in compliance with the International Municipal Signal Association 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.

25.06 POLES

A. EMBEDDED STEEL POLES

1. General

Poles shall conform in detail to the requirements set forth in this Specification and as shown on the plans. Each pole shall consist of a steel shaft, grounding terminal, wire inlet, hand hole and hand hole cover.

The following criteria shall be considered in the design of these poles:

25.06 POLES (continued)

a. Total weight of each luminaire - 40 pounds.
Effective projected area for each luminaire shall be 3 square feet.

b. Wind loads (wind velocity with gust factor is 104 MPH shall be 23.5 pounds per square foot on projected area of luminaires and pole sections.

c. Ice loads (unit weight of ice equals 56 pounds per cubic foot) shall be assumed 1 inch of ice loading shall be assumed on the horizontal projection of all exposed surfaces. A½" 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 inches 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 approximately 23 feet in length with a top outside diameter of approximately 3 inches and a bottom diameter of approximately 6". A 3" by 5" handhole with removable cover plate shall be centered approximately 18" above the ground line of the pole.

A grounding nut for accommodating a ½" 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.

A wire opening with a minimum diameter of one-and-one-half inches (1 ½") 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 inches below the ground line.

3. Painting

After all welds have been completed on the pole shaft, it shall be thoroughly cleaned of all loose scale and other foreign material, hot dip galvanized and finish painted 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 Engineer 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 Engineer.

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.

B. EMBEDDED 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 feet Nominal
b.	Burial Depth	4 feet Minimum
c.	Mounting Height	Per plan to light center of luminaire
d.	Handhole and Cover	2.5 inch diameter round, 18 inches above grade
e.	Alternate Handhole and Cover	2.5 to 3 inches by 5 inch oval
f.	Tenon Top	3 inches outside diameter by 3.5 inches long steel or molded
g.	Wire Entrance Hole	1 inch to 1.5 inches minimum grommeted, 24 inches below grade
h.	Pole Butt	Approximately 7 inches diameter, square or non-symmetrical
i.	Taper	0.120 to 0.150 inches per foot of length

3. Weight: Not greater than 65 pounds

4. Color: Black or grey, as specified on the plans

5. Performance Criteria

In accordance with Section 25.06.A.1.a,b,c of the Article

The lateral breaking strength load in pounds of the pole at any point on the pole shall be equal to or exceed two and one-half times the total wind loading moment at the ground line of the pole, computed for the above criteria. The total wind loading moment shall include moment due to luminaire, moment due to pole, and moment due to luminaire resting on a maximum wind load deflected pole.

25.07 LUMINAIRES

Luminaires shall be supplied as directed on the plans.

25.08 LAMPS

Lamps shall meet ANSI Standards in all respects. Lamps shall be Clear High Pressure Sodium Vapor, Universal Burn type and the wattage as shown on the plans. All lamps shall be non-cycling and must pass TCLP (Toxic Characteristic Leaching Process) limits.

Performance Data:

Rated Average Life at 10 hr/start	24,000 hours
% Mean Lumens at 10 hr/start	90%
Warm-up Time	3-4 minutes
Restart Time	1 minute

Physical Description:

Base Designation	Mogul
Bulb Designation	E-23-1/2
Bulb Finish	Clear
Light Center Length	5 inches
Bulb Temperature Limitations (maximum)	400º C
Base Temperature Limitations (maximum)	210º C

Electrical Description:

Nominal Lamp Watts	70
Nominal Lamp Volts	52
Nominal Lamp Current	1.6 Amperes
Maximum Crest Factor	1.8

Starting Pulse Requirements:

Pulse Peak Voltage (minimum)	2500
Pulse Peak Voltage (maximum)	4000
Pulse Width	1 Microsecond (minimum) at 2250
Pulse Repetition	50 per second
Pulse Peak Current	0.2 Amperes (minimum)

25.09 ELECTRICAL CABLE

See Section 24.11.A.5 of these Specifications

25.10 PHOTOELECTRIC CONTROLS

See Section 24.23.5 of these Specifications

25.11 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.

25.12 PULL BOXES

Pull boxes shall be installed at the locations shown on the plans. The Contractor may install, at his own expense, any additional pull boxes that may be desired to facilitate the work. The type and size of pull box shall be indicated and shall meet requirements of Article 24.01 of these Specifications.

25.13 GRADES

All work shall conform to Article 24.01 of these Specifications.

25.14 TRENCHING AND BACKFILLING

All cables, trenched or plowed, shall be 24 inches in depth on rear lot lines and 30 inches in depth on front and side lot lines. Cable route along the curb shall be centered approximately 5.5 feet 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 inches in width.

The first four inches 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 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 inch 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 accordance 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 at Engineers/Contractors discretion.

25.15 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 accordance with the applicable chapters of these Specifications.

25.16 INSTALLATION OF POLES

A. EMBEDDED STEEL POLES

Embedded steel poles shall be backfilled with a high density modified polyurethane foam. The Contractor shall coat the entire vertical pole butt surface with foam from base 1 foot below ground line. The poles shall be masked to 1 foot below the ground line to prevent splattering and provide a uniform edge.

All holes for poles shall be drilled or augered. 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 six inches (6") nor less than two inches (2"). Depths of holes shall be determined by embedment length requirements of the pole, but shall in no case be less than four feet (4').

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 six inch (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 ½" sieve	90-100%

A ground rod shall be set in undisturbed earth 24 inches from the outside edge of the augered pole with the top of the ground rod 12 inches below grade. A continuous ground wire shall connect the ground rod to the grounding lug on the pole.

Handholes shall be oriented so that they are opposite the direction of vehicle traffic on the side of the road at which the pole is installed.

Nylon slings shall be used to handle all poles to prevent damage to the paint. All poles shall be left clean after erection, and damaged paint shall be sanded and repainted.

A small section of 1" 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 poly 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 Observer. The age of the polyurethane 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 denisty of not less than 4.2 pounds per cubic foot and shall have a sheer strength not less than 38 p.s.i. and shall have a compressive strength not less than 75 p.s.i.

The foam shall be tested when required by the Engineer in accordance with ASTM D 2856/ANSI K 65.152; ASTM D 1623/ANSI K65.32; and ASTM D 1621/ANSI K65.31.

25.16 INSTALLATION OF POLES (continued)

B. FIBERGLASS POLES

Fiberglass poles shall be installed in the same manner as set forth in Article 25.16A, 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 accordance 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 inches plus the diameter of the tamper foot, but not greater than the tamper foot diameter plus 6 inches.

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.

Before backfilling, all standing water shall be removed from the hole. Crushed rock in accordance with Article 25.16.A 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 inch 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 inches. All excess backfill material shall be removed promptly from the site.

A ground rod shall be installed a minimum of 24 inches from the nearest edge of the augered hole and a minimum of 12 inches 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.

25.17 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.

25.18 INSTALLATION OF CABLE AND CONDUIT

Conduit shall be installed in accordance with Article 24.10 of these Specifications.

Cable installed in conduits shall be installed in accordance with Article 24.11 of these Specifications.

Aerial cable shall be installed in accordance with Article 24.11 of these Specifications.

Direct burial cable shall be installed in a dug trench at a depth of 24 inches on rear lot lines and 30 inches on front and side lot lines unless obstructions interfere. Along the street the cable shall be installed approximately 5.5 feet 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.

1 ½ inch Schedule 40 PVC conduit shall be installed under all existing paved roadways, sidewalks, or driveways that have to be crossed, unless otherwise specified.

25.18 INSTALLATION OF CABLE AND CONDUIT (continued)

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 Engineer 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 Engineer shall approve of such rerouting.

All electrical connections shall be as shown on the plans. 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 one (1) week prior to doing work. The Lincoln Electric System will provide door hangers.

25.19 INSTALLATION OF PHOTOELECTRIC CONTROLS AND LAMPS

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.

Lamps shall not come in contact with any foreign materials or liquids.

The Contractor shall plainly record the installation dates on lamps and photocells in the spaces provided by the manufacturer.

25.20 POWER SUPPLY AND RISERS

Locations of power supplies are shown on the plans. The bottom 10' of power supply risers shall be 1 ½ inch) schedule 80 PVC or steel conduit unless otherwise specified and shall be mounted in accordance with Lincoln Electric System specifications. All steel risers shall be grounded. All pole risers shall be on stand off brackets provided by LES and can be picked up at the Lincoln Electric System store room. See LSP 83 for spacing detail. Power supplies from transformers or service pedestals shall be installed by the Contractor. Notify LES to make final connection

25.21 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.

25.22 SECONDARY CONNECTIONS

When all work has been completed and the luminaires are ready to be energized, the Contractor shall notify the Lincoln Electric System.

25.23 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 two (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.

25.24 MEASUREMENT AND PAYMENT

Measurement and payment for ornamental street lighting is on a per unit basis in accordance with the General Conditions of the City of Lincoln Standards and Specifications.

CITY OF LINCOLN, NEBRASKA, STANDARD SPECIFICATIONS

Chapter 30

SEEDING AND SODDING

ARTICLE	TITLE
30.00	Description
30.01	Related Items Specified Elsewhere
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CHAPTER 30

SEEDING AND SODDING

30.00 DESCRIPTION

A. 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.

B. This work shall consist of furnishing, delivering and planting of plant material and all operations incidental thereto, in accordance with City of Lincoln Standard Plans, the Special Provisions, and these Specifications

30.01 RELATED ITEMS SPECIFIED ELSEWHERE

Chapter 2	Earthwork
Chapter 31	Landscaping Work
Chapter 32	Erosion Control

30.02 QUALITY ASSURANCE

A. 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.

B. 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.

C. 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.

D. Contractor must comply with American Sod Producers Association Classes of sod materials.

E. The City Engineer, Landscape Architect or Representative may inspect sod, seed or plugs at site before planting, for compliance with requirements for genus, species, variety, size and quality. The City Engineer, Landscape Architect or Representative may reject unsatisfactory or defective material at any time during progress of work. Rejected materials shall be immediately removed from project site.

F. 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 accordance 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.

30.03 SOURCE QUALITY CONTROL

A. Ship materials with certificates of inspection required by governing authorities. Comply with regulations applicable to sod, seed and materials.

B. Do not make substitutions. If specified sod, seed and other materials are not obtainable, submit proof of non-availability to City Engineer, Landscape Architect or Representative.

C. Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance 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.

30.04 PLANTING SEASON

Within thirty (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 Engineer, Landscape Architect or Representative. 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 30. September 1 - October 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 season only, except when prior written permission is obtained from the City Engineer, Landscape Architect or Representative. 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.

30.05 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 insure 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 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.

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 Engineer without payment being made therefor.

5. A representative sample of all material shall be submitted to the City Engineer, Landscape Architect or Representative 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 therefor.

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 accordance with good horticultural practices.

9. Substitution of specified materials shall not be permitted unless authorized by the City Engineer, Landscape Architect or Representative**.**

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 Engineer, Landscape Architect or Representative 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 Engineer may approve use of the seed if the information on the analysis is satisfactory. A minimum of eighty-five percent (85%) pure live seed (purity x germination x 100) is required for approval. Grass seed mixtures shall comply to the formulas provided in the seeding tables.

Listed below are Specifications for each type of grass seed mixture. Included in each Specifications are the grasses which are approved for use in that mixture. Other cultivars may be approved by the Engineers, Landscape Architect or City's Representative provided they are recommend by the most current NEBGUIDE, titled "Recommend Turfgrass Cultivars", published by the Cooperative Extension Service of the University of Nebraska at Lincoln, or by the Extension Turfgrass Specialist.

30.05 MATERIALS (GENERAL INFORMATION) (Continued)

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
Seeding Period:	April 15 - May 30; September 1 - October 15
Composition:	60% Bluechip, Blue Moon and NuBlue Ky. Bluegrass, 40% Accent or Caddieshack and SR4220 Perennial Ryegrass
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, lo
Location:	Parks and lower maintenance areas with or without irrigation. Mowing required.
Seeding Period:	April 15 - May 30; September 1 - October 15
Composition:	88% Arid 3, Jaguar 3, Masterpiece and Rembrandt (E), Turf TypeTall Fescue 7%, Blue Chip and NuBlue Kentucky Bluegrass - 5% Turf Type Perennial Ryegrass.
General Application:	Seed 5 to 6 lbs./M Sq. Ft.
Overseed Application:	Overseed 2 to 3 lbs./M Sq. Ft.

TYPE "C" Buffalograss (Low maintenance turf in sunny locations)

For use in sunny locations receiving little or no supplement water beyond establishment and requiring minimal mowing.

Buffalograss cultivars including: Legacy, Cody, Bowie, Bison, Texoka, Tatanka

Description:	Low growing, 4" - 8" little or no mowing
Location:	Medians, Boulevards, Open Space areas
Seeding Period:	April 15 - May 30; September 1 - October 15
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.

30.05 MATERIALS (GENERAL INFORMATION) (Continued)

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)
Seeding Period:	April 15 - May 30; September 1 - October 15
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:
Seeding Period:	April 15 - May 30; September 1 - October 15
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 (½ 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 bromegrass with deep rooting fescue	
Location:	County Roads, Rural NRD Projects	
Seeding Period:	April 15 - May 30; September 1 - October 15	
Composition:	See Below	
General Application:	Smooth Bromegrass, 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	

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
Seeding Period:	May 1 - May 30; September 1 - October 15
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 Rya 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
Seeding Period:	April 15 - May 30; September 1 - October 15
Composition:	Big Bluestem, Canada Wildrye, Red Top, Reed Canarygrass, 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
Seeding Period:	April 15 - May 30; September 1 - October 15
Composition:	57% Smooth Bromegrass, 11.50% Orchardgrass, 11.50% Tall Fescue and 20% Switchgrass.
General Application:	Apply 24 Lbs./Acre
Overseed Application:	N/A

C. SOD (GENERAL)

1. Sod shall be taken from sources approved by the City Engineer, Landscape Architect or Representative.

2. The sod shall be a first class representation of normal cultivars of bluegrass, fescue, buffalo grass or zoysia.

3. The Contractor shall furnish to the City Engineer, Landscape Architect or Representative, 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 inch. 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 TypeTall Fescue
Bluegrass/Fescue Blend
Buffalo Grass (Legacy, Cody, Bowie, Bison, Texoka, Tatanka)
Zoysia Grass

D. GRASS PLUGS (GENERAL)

1. Grass plugs shall be taken from sources approved by the City Engineer, Landscape Architect or Representative.

2. The plugs shall be a first class representation of normal cultivars of specified grass.

3. The Contractor shall furnish to the City Engineer, Landscape Architect or Representative 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)
Zoysia Grass

E. FERTILIZER

All fertilizer shall be checked and approved by the City Engineer, Landscape Architect or Representative 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 fertilize 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 (P_2O_5)___%
      Soluable Potash (K_2O)__%

   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 Landscape Architect, Engineer or Representative. 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 accordance with these Specification or as directed by the City's Engineer, Landscape Architect or Representative. Components of bulk blends must be close in particle size to prevent segregation. The City's Engineer, Landscape Architect or Representative may approve immediate use of any commercial turf or fertilizer which is registered for sale in Nebraska.

30.05 MATERIALS (GENERAL INFORMATION) (Continued)

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 ½ inc or less screen opening. The compost shall be free of all inorganic debris. LINGRO compost is available from the City of Lincoln's Sold Waste Operation - contact Gene Hanlon (402) 441-7043. Ratio of topsoil to compost should be a minium of 2 to 1.

H. MULCH

Mulching shall be applied in such a manner as to remain in place. 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 two thousand (2,000) pounds per acre with a three percent (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 one (1) cubic yard per one thousand (1,000) square feet. The peat moss will be pulverized, will not be less than sixty percent (60%) decomposed organic matter by weight, and will have a pH from four (4) to six (6).

3. Prairie Hay: If hay shall be used, it shall be applied evenly over the seeded surface at the minimum rate of two (2) tons per acre.

4. Wheat Straw: If wheat straw shall be used, it shall be applied at the rate of three (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 Engineer, Landscape Architect or Representative.

An alterative may be approved by the City Engineer, Landscape Architect or Representative. Hay shall be obtained from local source.

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.

30.06 GENERAL CONSTRUCTION METHOD

A. Examine finish surfaces, grades, topsoil quality and depth. Do not start seeding, sodding or plugging work until satisfactory conditions are corrected.

B. **Under Ground Facilities. 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 five (5) feet from lateral underground utility lines (i.e. electric, gas, water, etc.) shall require contacting the City Arborist for street trees or City Landscape Architect or Engineer for park trees so that alternate planting location(s) can be marked.

C. 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. The areas shall be prepared not more than three days prior to the installation of materials. Loosen topsoil of areas to a minimum depth of 2 inches. Remove stones over 1 inch in any dimension and sticks, roots, rubbish and extraneous matter.

4. The seed bed shall be prepared not more than three (3) days prior to the installation of seed, plugs, or sod by loosening the soil to a depth of not less than 2 inches nor more than 4 inches by discing, 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.

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 inch in their largest dimension. All lumps of soil shall be pulverized, raked out or removed.

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 ½" below the paved surface in the case of seeding or plugging and 3/4 inch 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.

D. 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 Engineer.

On the basis of the guaranteed analysis, the Engineer 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 insure that 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 chooses 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 Section 30.05.

E. 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.

F. BASIS OF PAYMENT

1. GENERAL

   The Contractor shall seed, sod, or plug all areas disturbed by construction operations. Limits of the sodding, plugging or seeding areas to be used in determining payment quantities are indicated which lies outside those limits shall be sodded, plugged or seeded at the Contractor's expense. No separate measurement or payment shall be made for soil preparation. This work shall be considered seeding, sodding, or plugging for which direct payment is made.

2. SODDING

   Sodding completed in conformance with the plans and Specifications and accepted 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.

3. PLUGGING

   Plugging completed in conformance with the plans and Specifications and acceptable to the Engineers 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, fertilize, water establishment period and incidentals necessary to complete the work.

F. BASIS OF PAYMENT (Continued)

4. SEEDING

Seeding of the various types called for on the plans, completed in conformance with the plans and Specifications and acceptable to the Engineer, Landscape Architect or City's Representative 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.

30.07 COVER CROP

A covercrop may serve as an alternative to providing soil cover when seeding, sodding or plugging is not an alternative. The purpose of selection a cover crop us to prevent soil erosion by wind and water. Cover crops may be used in situations in the following situations:

A. The window for seeding, sodding or plugging has passed.

B. If a quick cover is necessary to prevent erosion prior to the completion of the project.

C. 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.

1. EARLY SEASON (SPRING COVER CROP)

A spring cover crop is planted in early spring to provide soil cover during the spring. Alternatives include:

Type of Seed	**Application Rate Lb/acre**
Annual Rye	20 - 25
Winter Rye	20 - 25
Fescue	15
Alfalfa (Ranger or Vernal)	18
Seeding Period:	March 1 to 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.

2. 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:

Type of Seed	**Application Rate Lb/acre**
Annual Rye	20 - 25
Fescue	15
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.

30.07 COVER CROP (Continued)

3. 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:

Type of Seed	**Application Rate Lb/acre**
Winter Rye	20 - 25
Fescue	15
Alfalfa (Ranger or Vernal)	18
Seeding Period:	August 1 - September 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.

30.08 SEEDING

The seeding operation shall be restricted to the periods listed under the seeding mixtures (31.05) unless otherwise authorized by the City's Engineer, Landscape Architect or Representative. No work shall be accomplished when the ground is frozen, or otherwise untillable.

Appropriate mechanical spreaders approved the City's Engineer, Landscape Architect or Representative. Hydraulic seeding equipment also may be used when approved by the City's Engineer, Landscape Architect or Representative. 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 STANDARDS AND SPECIFICATIONS.

B. TOPSOIL

Topsoil preparation will be as described in this Section, Topsoil Preparation, of these STANDARDS AND SPECIFICATIONS.

C. BOOSTER FERTILIZER

All fertilizer requirements will meet the requirements of this Section, Topsoil Preparation, of these STANDARDS AND SPECIFICATIONS. A booster fertilizer with the chemical analysis of Nitrogen-18, Phosphorous-46, Potash-0, with four percent (4%) iron and eight percent (8%) sulfur will be applied on the prepared soil at the rate of five (5) pounds per one thousand (1,000) square feet immediately prior to seeding.

D. SEED

Seed will be furnished in sealed, unopened, standard containers and labeled in accordance 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 Seed". The City at the Contractor's expense may require tests of seed verification.

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 (Refer to Section 30.05 G).

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 one-quarter inch (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 Engineer, Landscape Architect or City's Representative. 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 accordance with the requirements of this chapter as stated for "Seeding".

      All equipment and materials shall be approved by the Engineer, Landscape Architect or City's Representative prior to the seeding operation.

3. NATIVE SEEDING

   A. Whenever possible, the seed will be applied using a drill-type seeder. Seed will be sown to a depth of one-half inch (½") 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 two percent (2%) iron at the rate of five (5) pounds per one thousand (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 accordance with these STANDARDS AND SPECIFICATIONS at the Contractor's expense.

H. WATERING

The Contractor will be responsible for watering the seeded area(s) a minimum of two (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 such time as the project is accepted by the City Council.

I. INSPECTIONS

Inspections shall be completed in accordance with this Section, Inspections, of these STANDARDS AND SPECIFICATIONS. The Contractor must notify the City for inspections of seed certification and germination.

J. GERMINATION INSPECTIONS

When germination is complete and plants are visible, the Contractor will notify the City and request a germination inspection for approval in order to begin the guarantee period. Any areas deemed by the City 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 thirty (30) days shall be re-seeded as specified for “Seeding” above.

30.09 SODDING

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 seven (7) days after it is replaced.

30.09 SODDING (Continued)

A. GENERAL

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 STANDARDS AND SPECIFICATIONS.

B. TOPSOIL

Topsoil preparation will be as described in this Section, Topsoil Preparation, of these STANDARDS AND SPECIFICATIONS.

C. BOOSTER FERTILIZER

All fertilizer will meet the requirements of Section 820.00, Topsoil Preparation, of these STANDARDS AND SPECIFICATIONS. A booster fertilizer with a chemical analysis of Nitrogen-12, Phosphorous-12, Potash-4, with four percent (4%) iron and eight percent (8%) sulfur will be applied at a rate of five (5) pounds per one thousand (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 twenty-four (24) hours from the time it is cut, unless it can be stored to the satisfaction of the City. 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.

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.

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 one foot (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 four horizontal to one vertical (4:1) will be staked with wood or wire pins not less than six inches (6") long and spaced not more than thirty inches (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 three inches (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.

30.09 SODDING (Continued)

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 Council. 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 by the City 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 three inches (3"). Frequency of mowing will be determined by the growth rate of the grass but at no time should the clippings exceed two inches (2") in length. Only turf-type mowers will be used for this operation.

I. ADDITIONAL FERTILIZING

Thirty (30) days after sod is laid, an application of fertilizer with the chemical analysis of Nitrogen-12, Phosphorous-12, Potash-4, with four percent (4%) iron and eight percent (8%) sulfur will be applied at the rate of six (6) pounds per one thousand (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 two (2) times per day (mid-morning and late afternoon) and for keeping the areas moist for a period of fourteen (14) days following the initial sodding operation and until the sod is established.

K. INSPECTIONS

Inspections shall be completed in accordance with this Section, Inspections, of these STANDARDS AND SPECIFICATIONS. The Contractor must notify the City for inspection of sodding. When sodding operations are complete, the Contractor will notify the City and request a sodding inspection for approval in order to begin the guarantee period. Any areas deemed by the City 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 fourteen (14) days following the replacement.

30.10 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 STANDARDS AND SPECIFICATIONS.

B. TOPSOIL

Topsoil preparation will be as described in this Section, Topsoil Preparation, of these STANDARDS AND SPECIFICATIONS.

C. SOD PLUGS

The Contractor shall obtain from strongly rooted nursery grown sod composed of the following grass species (Refer to Section 30.06) 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.

E. BOOSTER FERTILIZER

1. Fertilizer shall be a commercial turf product containing nitrogen, available phosphoric acid (P205) and soluable 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 buffalograss can be sprayed with Roundup or equivalent to control winter weeds. Fall applications can be applied after the first frost or when the buffalograss 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 bufalograss 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 twenty-four (24) hours from the time harvested, unless it can be stored to the satisfaction of the City. 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 sod survival.

3. Protect sod plugs from sun, wind, and dehydration prior to installation.

30.10 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 soil around plugs after planting. DO no cover tips.

3. Space plugs 12 inches on center each direction or as otherwise specified by the City Engineer, Landscape Architect or Representative.

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 for 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 fourteen (14) days after planting. After fourteen (14) days, the plugged areas shall be watered once per day for fifteen (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 Engineer, Landscape Architect or Representative.

9. Apply Plateau herbicide, or approved equal pre-emergent control within 5 days after initial watering at a rate of 1 ounce per acre.

10. Apply starter fertilizer to sodded areas at a rate equal of 1.0 pound of actual nitrogen per 1,000 square foot. Apply first application of fertilizer three (3) weeks after initial sodding. Apply fertilizer by mechanical rotary or dry type distributor, thoroughly and evenly incorporated across the sodded areas. Apply second application of fertilizer eight (8) weeks after initial sodding.

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 Engineer, Landscape Architect or Representative.

30.10 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 Engineer, Landscape Architect or Representative.

2. A nitrogen fertilizer should be used every thirty (30) days until fully established.

3. Keep all plugged areas thoroughly watered for sixty (60) days after final acceptance of the entire project per the Specifications. Any portion of the plugged area that is not in good growing condition at the end of the sixty (60) days shall be re-plugged as specified above.

4. Being mowing the plugged area as soon as the plugs attain a height of 3 inches and cannot be easily pulled out of the soil. Maintain all plugged areas at a height of 3 inches for sixty (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 sixty (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.

K. INSPECTIONS

Inspections shall be completed in accordance to these STANDARDS AND SPECIFICATIONS. The Contractor must notify the City for inspection of plugged areas. When operations are completed, the Contractor will notify the City Engineer, Landscape Architect or Representative and request an inspection for approval in order to begin the guarantee period. Any areas deemed by the City to be thin, weak or dead will be replaced at this time.

30.11 ACCEPTANCE AND ESTABLISHMENT PERIOD

A. Upon completion of planting the City Engineer, Landscape Architect or Representative 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 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 materials may be allowed to remain in place without payment. A subsequent inspection may be made subsequent to the initial inspection to determine the acceptability of material and therefore, allowing payment for such materials.

B. During the establishment period, the Contractor shall property maintain all materials planted under the contract. The establishments 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 Engineer, Landscape Architect or Representative, including the removal of any dead plant material for the project. **Note: the Contractor is responsible for watering all plant material as necessary during the establishment period.**

30.11 ACCEPTANCE AND ESTABLISHMENT PERIOD (Continued)

C. The establishment period will follow the completion of all planting and shall extend for a period of:

SEED	Thirty (30) days
SOD	Fourteen (14) days
PLUGS	Sixty (60) days

The establishment period will not begin until all of the following items of work as required in the 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.

D. Upon completion of the establishment period, the City Engineer, Landscape Architect or Representative will make an inspection of 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.

30.12 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	Sixty (60) days
SOD	Thirty (30) days
PLUGS	Ninety (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 Engineer, Landscape Architect, or Representative 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 specifications stated herein.

The guarantee of all **replacement** plants shall extend for an additional period of:

SEED	Sixty (60) days
SOD	Thirty (30) days
PLUGS	Ninety (90) days

30.12 REPLACEMENT OF MATERIAL AND GUARANTEE PERIOD (Continued)

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 Engineer, Landscape Architect or Representative may elect subsequent replacement or credit (refund) for them.

30.13 VANDALISM

Seeded/Sodded/Plugged areas damaged as a result of vandalism are not required to be replaced as apart of this contract.

30.14 QUALIFICATIONS FOR SUBMITTING BIDS

A. Contractor must be able to demonstrate a minium work experience record.

B. Contractor must be able to demonstrate successfully completed projects similar to scope and scale.

30.15 REQUIREMENTS FOR SUBMITTING BIDS

All bids submitted must include the following information on the **BID PROPOSAL:**

A. The unit price for each type of seed mix/sod or plug variety listed on bid PROPOSAL is to include furnishing, delivery and installation at various locations throughout the City of Lincoln.

B. The quantity of seed/sod/plugs which can be furnished is to be entered on the bid form. Total price is the unit price multiplied by the quantity that bidder can provide in relation to the quantity needed per project completion.

C. All bid prices shall be firm and shall include all necessary labor, materials and equipment required as specified within these specifications.

D. Bids submitted shall conform to the contract forms and the specific requirements of these specifications.

E. Specified seed/sod/plug materials shall conform to the measurements specified on the bid PROPOSAL list.

CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

Chapter 31

LANDSCAPE WORK

ARTICLE	TITLE
31.00	Description
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31.02	Planting Season
31.03	Materials
31.04	Receiving and Storing of Plant Material
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CHAPTER 31
LANDSCAPE WORK

31.00 DESCRIPTION

A. 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.

B. Nomenclature used in these 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.

C. Plant material shall mean trees, shrubs, vines, ground covers and plants of all descriptions, required to be furnished for the project, in accordance with these Specifications, the Special Provisions, and the details shown in the plans.

D. This work shall consist of furnishing, delivering and planting of plant material and all operations incidental thereto, in accordance with City of Lincoln Standard Plans, the Special Provisions, and these Specifications.

31.01 QUALITY ASSURANCE

A. All plant material shall conform to the American Standard for Nursery Stock (ANSI Z60.1-2004 or most current)

B. Contract landscape work to a single firm specializing in the growing and planting of plant material. Firm shall have satisfactory record of performance on completed projects of comparable size and quality.

C. Trees, Shrubs and Plants: Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.

D. If specified landscape material is unobtainable, submit proof to City Arborist, Landscape Architect or Engineer together with proposal for use of equivalent material.

E. The City Arborist, Landscape Architect or Engineer may inspect trees and shrubs 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 Arborist, Landscape Architect or Engineer may reject unsatisfactory or defective material at any time during progress of work. Rejected trees or shrubs shall be immediately removed from project site.

31.01 QUALITY ASSURANCE (Continued)

F. 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 accordance with methods established by the Association of Official Agriculture Chemists. Include soil amendments and fertilizer materials.

Container-Grown Material: Submit samples of all container-grown material prior to planting.

List of Sources: Submit 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 Arborist, Landscape Architect or Engineer. 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 June1 for all deciduous materials and May 1 toJune 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 Arborist, Landscape Architect or Engineer. 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.

31.03 MATERIALS (Continued)

3. All plant material furnished shall be true to name and type and legible labels shall be furnished to insure 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 roosts, broken balls, insect pests, diseases, or which are not found to comply with these 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 therefor.

7. A representative sample of all container grown and/or pot grown material shall be submitted to the City Arborist, Landscape Architect or Engineer for approval prior to planting if requested.

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.

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 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 accordance 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.

31.03 MATERIALS (Continued)

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 inch in diameter that are not completely callused, shall be rejected.

20. All plant material is subject to visual inspection by the City Arborist, Landscape Architect or Engineer 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 Arborist for street trees and the Landscape Architect or Engineer for park trees or other City landscape projects at least five (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 Arborist, Landscape Architect or Engineer.

22. Plants shall conform to the measurements specified, except that plants larger than those specified may be used if approved by the City Arborist, Landscape Architect or Engineer. 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 six (6) inches above the natural ground line for trees up to four (4) inches in caliper and twelve (12) inches above the natural ground line for trees over four (4) inches 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.

31.03 MATERIALS (Continued)

24. If a range of size is given, no plants shall be less than the minimum size and no less than fifty percent (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. ⅓ to ½ the total height of the tree is a trunk free of branching and the other ½ to⅔ 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 specification. Plant material not meeting this specification may be rejected by the City.

26. The minimum height growth for pine trees shall be as follows: a) trees 3 - 5 feet in height shall have at least 2 feet of new height growth during the last 2 growing seasons, and b) trees 5 foot and over in height must have at least 3 feet of new height growth during the last 3 growing seasons.

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 girding 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. 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.

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 ½ inc or less screen opening. The compost shall be free of all inorganic debris. LINGRO compost is available from the City of Lincoln's Sold Waste Operation - contact Gene Hanlon (402) 441-7043. Ratio of topsoil to compost should be a minium 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 ½" 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 accordance 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. Roots transplant 1-step (2-2-2) shall be provided by the City.

H. STAKES

Stakes shall be 2 inch x 2 inch wooden stake of suitable length to adequately support the plant material. The top six inches of the stake shall be painted with red paint as a safety warning feature. Typically, stakes will be a minimum of six (6) feet in length. Stakes shall be driven at least 12" into the soil for secure support.
(Refer to detail on page(s) 3108 - 3110)

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). The support shall be tied in a figure eight (8) loop between the tree and the stake(s) to allow for flexibility. Do not tie trees too rigidly to stakes.
(Refer to detail on page(s) 3108 - 3110)

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.

31.04 RECEIVING AND STORING OF PLANT MATERIALS

A. Storage facilities for plant material must receive approval of the City Arborist, Landscape Architect or Engineer prior to delivery of the plant material. The storage facility shall have an adequate water supply, shade, good ventilation, and protection from drying winds.

B. 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

A. **Delivery and/or the planting of street trees shall be coordinated with the City <u>Arborist, Landscape Architect or Engineer</u> at (441-7847) at least 24 hours before planting or delivery**. The successful bidder(s) shall notify the Arborist, Landscape Architect or Engineer 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 specification requirements and approval by the City upon delivery and/or at time of planting, unless a request has been made for inspection prior to delivery.

B. 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.

C. **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.

D. **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.

31.05 TRANSPORTING PLANTS TO THE PLANTING SITE (Continued)

E. **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.**

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 Arborist 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 Arborist on a **daily** basis by no later than 8:00 a.m. 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 roads for all vehicles. Permission to travel with any equipment anywhere other than the established roads must be obtained from the Landscape Architect or Engineer.

B. **Park Trees and Other Landscaped Areas.** A list of designated locations for park trees will be provided by the City Landscape Architect or Engineer 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 Landscape Architect or Engineer on a **daily** basis by no later than 8:00 a.m. 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 roads for all vehicles. Permission to travel with any equipment anywhere other than the established roads must be obtained from the City Landscape Architect or Engineer.

31.07 SITE PREPARATION

A. Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

B. Layout individual tree and shrub locations. Stake locations and secure City Arborist, Landscape Architect or Engineer's acceptance before start of planting work. Make minor adjustments as may be requested. Installation of plant material may not begin until City Arborist, Landscape Architect, or Engineer has approved planting locations.

C. **Under Ground Facilities. 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 five (5) feet from lateral underground utility lines (i.e. electric, gas, water, etc.) shall require contacting the City Arborist for street trees or City Landscape Architect or Engineer for park trees so that alternate planting location(s) can be marked.

31.08 PLANTING OF TREES AND SHRUBS

A. 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 Arborist, Landscape Architect or Engineer prior to use. Trees shall be planted at the designated locations in the manner as shown in the plans and in accordance with sections of the Specifications that are applicable. Tree pits may either be dug manually or mechanically using an auger or tree spade.

B. 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.

C. 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.

D. **(Refer to detail on page 3107, showing root ball in reference to soil line and back-fill)**

E. 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.

F. 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.

G. 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, <u>never by the trunk.</u>

H. Plants shall be set so that the trunk flare is exactly at the existing grade in loamy or sandy soils and 1" to 2" above the existing grade in clay or poorly drained. 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.

I. Plants must be plumb (straight) and centered in the planting hole before backfilling and after planting is complete.

J. Fertilizer shall be an approved root biostimulant (i.e. Roots by City). Apply according to the directions on the label.

K. 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.

31.08 PLANTING OF TREES AND SHRUBS (Cont.)

L. If the plant is balled and burlapped all rope, strings, twine, wire, and wrapping from the top one-half (½) 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.

M. 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 Arborist, Landscape Architect or Engineer. 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.

N. 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 twelve (12) inches before backfilling. Topsoil shall be gently firmed around the plant to hold it in place and toeliminate air pockets. When pits are approximately two-thirds (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.

O. After the planting pit has been completely backfilled, make a ridge of soil two (2) to four (4) inches in height is to be formed around the outside margin of the pit to create a reservoir for watering.

P. Top of planting pits are to be mulched with a two (2) to four (4) inch layer of wood chips five (5) feet 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.

Q. 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.

R. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify City Arborist, Landscape Architect, or Engineer. Hand excavate near underground utilities. Maintain grade stakes set by other until removal is agreed upon by all parities considered.

31.09 PLANTING PERENNIALS AND ORNAMENTAL GRASSES

A. Prepare soil at perennial areas by spading deeply to a depth of at least 8 inches 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 inch depth. Rake planting bed smooth. **NOTE: Some ornamental grasses may not require compost, so verify with Arborist, Landscape Architect or Engineer.**

B. 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.

C. Mulch perennial plants. Provide not less than 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.

D. **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.

E. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify City Arborist, Landscape Architect, or Engineer. Hand excavate near underground utilities. Maintain grade stakes set by other until removal is agreed upon by all parities 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.

31.11 STAKING AND SUPPORT OF PLANT MATERIAL (Continued)

Street Trees are to be secured after planting by a single support stake driven at approximately a 45^0 (degree) angle to the ground plane avoiding the root ball. Stakes are to be driven to a minimum depth of 12 inches 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 detail on Page 3108)**

Deciduous **Park Trees & Trees in other Landscaped Areas** are to be secured after planting by two support states driven at approximately 90^0 (degree) angle to the ground plane avoiding the root ball. Stakes are to be driven to a maximum depth of 12 inches 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 detail on Page(s) 3109 and 3110)**

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

A. **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 two (2) inches in diameter at the base of the trunk. Coniferous trees shall be marked with a colored tag placed on a side branch, <u>not</u> 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 <u>not</u> to be placed in mail boxes.

31.14 ACCEPTANCE AND ESTABLISHMENT PERIOD

A. Upon completion of planting the City Arborist, Landscape Architect or Engineer 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 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 thirty (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)

B. During the establishment period, the Contractor shall property maintain all plant materials planted under the contract. The establishments procedures shall include additional pruning, protective measures against pests and diseases, watering as often as required by necessity, cultivating, repairing dames 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 Landscape Architect or Engineer, including the removal of any dead plant material for the project. **Note: the Contractor is responsible for watering all plant material as necessary during the one year establishment period.**

C. 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 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.

D. Upon completion of the establishment period, the City Arborist, Landscape Architect or Engineer will make an inspection of 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 thirty (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 to in Section 31.07**. 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 guarantee period for trees shall begin at the date of acceptance.

The Contractor shall guarantee all plant material to be in healthy and flourishing condition for a period of one (1) year from 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 Arborist, Landscape Architect, or Engineer to be dead during or at the end of the guarantee period.

31.15 REPLACEMENT OF PLANT MATERIAL AND GUARANTEE PERIOD (Continued)

A. 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 Arborist, Landscape Architect or Engineer including the removal of any dead plant material from the project.

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 specifications stated herein.

The guarantee of all **replacement** plants shall extend for an additional period of one (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 Arborist, Landscape Architect or Engineer 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

A. Contractor(s) must be licensed according to the Nebraska Administrative Code for Plant Protection and Plant Pest Act.

B. Contractor(s) must be a Nebraska Certified Nurseryman and a current member of the Nebraska Nursery and Landscape Association.

C. Contractor must be able to demonstrate a minium work experience record.

D. Contractor must be able to demonstrate successfully completed projects similar to scope and scale.

31.18 REQUIREMENTS FOR SUBMITTING BIDS

All bids submitted must include the following information on the **BID PROPOSAL:**

Interested parties may complete and submit bid PROPOSAL for any or all of the four quads.

The unit price (i.e., cost per plant) for each species listed on bid PROPOSAL is to include furnishing, delivery and planting at various locations throughout the City of Lincoln. Plant material as specified on the bid PROPOSAL which cannot be furnished, delivered and planted should be noted in writing as "not available" on the bid PROPOSAL form.

The number of plants which can be furnished is to be entered on the bid form. This number may include all, or only a portion of the total quantity needed per plant species. Total price is the unit price multiplied by the quantity that bidder can provide in relation to the quantity needed per plant species.

All bid prices shall be firm and shall include all necessary labor, materials and equipment required as specified within these specifications.

Bids submitted shall conform to the contract forms and the specific requirements of these specifications.

Specified plant materials shall conform to the measurements specified on the bid PROPOSAL list, except that plants larger than specified may be accepted if approved by the City Arborist, Landscape Architect or Engineer. Acceptance of such plant materials shall not increase the unit price indicated on the bid PROPOSAL nor be an additional cost to the City.

CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS
Chapter 32

SOIL EROSION & SEDIMENT CONTROL

ARTICLE	TITLE
32.00	General
32.01	Related Work Specified Elsewhere
32.02	Sediment/Silt Fence A. General B. Materials C. Installation D. Maintenance and Removal E. Measurement and Payment
32.03	Construction Entrance A. General B. Materials C. Installation D. Maintenance and Removal E. Measurement and Payment
32.04	Riprap Apron Outlet Protection A. General B. Materials C. Installation D. Maintenance and Removal E. Measurement and Payment
32.05	Riprap Basin Outlet Protection A. General B. Materials C. Installation D. Maintenance and Removal E. Measurement and Payment
32.06	Filter Fabric Storm Drain Inlet Protection A. General B. Materials C. Installation D. Maintenance and Removal E. Measurement and Payment

32.07 Turf Reinforcement

A. General
B. Materials
C. Installation
D. Maintenance and Removal
E. Measurement and Payment

32.08 Triangular Sediment Barriers

A. General
B. Materials
C. Installation
D. Maintenance and Removal
E. Measurement and Payment

32.09 Straw Bale Barriers

A. General
B. Materials
C. Installation
D. Maintenance and Removal
E. Measurement and Payment

CHAPTER 32

SOIL EROSION AND SEDIMENT CONTROL

32.00 DESCRIPTION

A. This work shall consist of constructing, maintaining, and removing erosion control measures that are used to minimize siltation and sedimentation during construction. This work shall be performed at locations shown on the plans or as directed by the Engineer.

32.01 RELATED WORK SPECIFIED ELSEWHERE

Chapter 2 Earthwork
Chapter 9 Crushed Rock Surfacing
Chapter 20 Construction of Utilities & Structures
Chapter 21 Storm Sewers
Chapter 30 Seeding and Sodding
Chapter 31 Landscape Work

32.02 SYNTHETIC FABRIC SILT FENCE

A. GENERAL

Silt fence is a temporary linear sediment filter barrier constructed of synthetic filter fabric and posts. Silt fence shall be used for detaining small amounts of sediment and decreasing flow velocities.

B. MATERIALS

1. Filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene fabric and shall conform to the specifications defined in the following table:

Fabric Properties	Minimum Requirements	Test Method
Filtering Efficiency	70%	ASTM 5141
Tensile Strength at 20% (max.) elongation:		
Standard Strength	30 lb./linear inch	ASTM 4632
High Strength	50 lb./linear inch	ASTM 4632
Flow Rate	.2 gal./SF/minute	ASTM 5141
Ultrviolet Radiation Stability	90%	ASTM-G-26

2. Posts and stakes shall be standard “T” steel posts and be a minimum of forty (40) inches in length.

C. INSTALLATION

Silt/sediment fences shall be placed the same day excavating and/or fill and prior to any site disturbing activities upstream of the fence.

A four (4) inche wide by eight (8) inch deep trench shall be excavated along the line of the fence posts.

Posts shall be driven into the ground to a minimum depth of sixteen (16) inches below the original ground level and at approximately a twenty (20) degree incline toward the upslope side. The posts shall be spaced a maximum of six (6) feet apart for filter fabric not supported by wire mesh and a maximum of ten (10) feet apart for filter fabric supported by wire mesh.

The filter fabric shall be entrenched to a depth of no less than eight (8) inches of overlap and properly sealed according to the filter fabric manufacturer recommendations.

These requirements represent minimum installation requirements and do not replace the filter fabric manufacturer installation recommendation that may exceed these requirements.

For application, design, installation details see City of Lincoln Standard Plan LSP-175 and Section 9.6.2 of the City of Lincoln Drainage Criteria Manual.

D. MAINTENANCE AND REMOVAL

The silt/sediment fence shall be inspected once every two (2) weeks, within twenty-four hours after each rain event, daily during a prolonged rain event, and as directed by the Project Manager.

Sediment deposits shall be removed when the level of deposition reaches one half (½) of the silt/sediment fence of height. Removed sediment shall be placed in a suitable location and in a manor that minimizes further erosion.

If, during required inspections, damage to the silt/sediment fence is observed the necessary repairs shall be completed within twenty-four (24) hours of the inspection by the Contractor.

The silt/sediment fence shall not be removed until the up slope area has been permanently stabilized and/or directed by the Project Manager. All materials shall be completely removed from the site and stored or disposed of properly.

E. MEASUREMENT AND PAYMENT

Installation shall be paid for at the contract unit price per linear foot (LF) for “SYNTHETIC FABRIC SILT 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 installation work.

E. MEASUREMENT AND PAYMENT (Continued)

Maintenance shall be paid for at the contract unit price bid per linear foot (LF), per occurrence for "SYNTHETIC FABRIC SILT 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 Section 32.02.D above.

32.03 CONSTRUCTION ENTRANCE

A. GENERAL

A construction entrance is a stabilized stone 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 move directly onto a public road or other paved area.

B. MATERIALS

1. The stone shall be two (2) inch to three and one-half (3 ½) inch diameter, clean crushed rock or recycled concrete.

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.

Fabric Properties [1]	Light Duty [2]	Heavy Duty [3]	Testing Method
Grab Tensile Strength (lbs)	180	250	ASTM D4632
Elongation A Failure (%)	50	60	ASTM D4632
Mullen Burst Strength (psi)	250	380	ASTM D3786
Puncture Strength (lbs)	90	125	ASTM D4833
Apparent Opening Size (mm)	.20	.20	ASTM D4751

[1] Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

[2] Light Duty entrance shall be defined as sites that have been graded to multi-axle truck. Examples of fabrics which can be used are: Trevira Spundbond 1125, Synthetic Industries 701, Polyfelt TS650, or equivalent.

[3] Heavy duty entrance shall be defined as sites with only rough grading and where most travel would be multi-axle vehicles. Examples of fabrics which can be used are: Trevira Spundond 1135, Synthetic Industries 1001, Polyfelt TS750, or equivalent.

C. INSTALLATION

The minimum width of the entrance shall be twelve (12) feet for sites with multiple access points and twenty-four (24) feet for sites with a single access point. The minimum length of the entrance shall be seventy (70) feet.

The area of the construction entrance shall be excavated a minimum of three (3) inches 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 stone shall be placed over the entire length and width of the construction entrance at a thickness not less than six (6) inches. A three (3) foot wide by six (6) inch high hump of additional stone shall 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 Lincoln Standard Plan LSP-176 and Section 9.6.8 of the City of Lincoln Drainage Criteria Manual.

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 stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment.

Inspections shall be made at least once every seven (7) calendar days and after any storm even of greater than 0.5 inches or precipitation during any 24 hour period.

All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto roadways 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, stone surfacing, and any other materials used in the construction of the entrance shall be completely removed from the site and disposed of properly.

E. MEASUREMENT AND PAYMENT

Installation of the construction entrance shall be paid for at the contract unit price per ton for "CRUSHED ROCK SURFACING (IN PLACE)". This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing the materials, and for installation, maintenance, and removal work. The filter fabric shall be subsidiary to the construction of the entrance.

32.04 RIPRAP APRON

A. GENERAL

Riprap aprons are flat beds of crushed rock over geotextile filter fabric installed at storm drain outlets. Riprap aprons are energy dissipation measures that decrease flow velocity to a non-erosive level prior to entering an earthen channel.

B. MATERIALS

1. The riprap shall consist of clean crushed rock or recycled concrete subject to the following requirements: The size of the riprap shall be in accordance with Section 7.6 of the City of Lincoln Drainage Criteria Manual, as shown on the approved erosion and sediment control plan and as directed by the Project Manager; crushed rock must consist of limestone, quartzite, or other hard stone; riprap shall have a density of at least one-hundred forty (140) pounds per cubic foot (lb/CF); riprap shall have no dimension greater than three (3) times its leaset dimension; recycled concrete shall be clean and contain no asphalt.

2. Filter fabric shall meet the requirements of Section 32.03 of this chapter.

C. INSTALLATION

The area of the apron shall be excavated to a depth such that the surface of the apron is flush with the storm drain outlet and that accommodates the thickness of the apron. The area shall be cleared of all vegetation, roots, and other objectionable material. The thickness, shape, and size of the apron shall be in accordance with Section 7.6 of the City of Lincoln Drainage Criteria Manual, as shown on the approved erosion and sediment control plan, and as directed by the Project Manager.

The filter fabric shall be placed over the entire area of the apron. The riprap shall then be spread evenly over the entire area of the apron and leveled. The riprap may or may not be grouted in place according to the approved erosion and sediment control plan or as directed by the Project Manager.

For application, design, and construction details refer to Section 7.6 of the City of Lincoln Drainage Criteria Manual.

The riprap apron shall be constructed on the same day the storm drain outlet is constructed.

D. MAINTENANCE

The apron shall be inspected once every two (2) weeks, withing twenty-four (24) hours after each rain even, daily during a prolonged rain event, and as directed by the Project Manager.

Any riprap and/or filter fabric that has been displaced or damaged in any way shall be re-laid or replaced within twenty-four (24) hours by the Contractor.

Maintenance shall not cease until the entire storm drain system is complete and is given final approval from the City.

E. MEASUREMENT AND PAYMENT

Installation of the riprap apron shall be paid for at the contract unit price per ton for "CULVERT OUTLET PROTECTION INST". This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating and placing all materials, and for all labor, tools, equipment and incidentals necessary to complete the installation work. The filter fabric and grout shall be subsidiary to the construction of the apron.

Maintenance shall be paid for at the contract unit price bid per each, per occurrence for "CULVERT OUTLET PROTECTION MAINT". This price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in Section 32.04.D above.

32.05 RIPRAP BASIN

A. GENERAL

Riprap basins are depressed beds of crushed rock over geotextile filter fabric installed at storm drain outlets. Riprap basins are energy dissipation measures designed to decrease flow velocity to a non-erosive level prior to entering an earthen channel.

B. MATERIALS

1. The riprap shall consist of clean crushed rock or recycled concrete subject to the following requirements: The size of the riprap shall be in accordance with Section 7.7 of the City of Lincoln Drainage Criteria Manual, as shown on the approved erosion and sediment control plan, and as directed by the Project Manager; crushed rock must consist of limestone, quartzite or other hard stone; riprap shall have a density of at least one hundred forty (140) pounds per cubic foot (lb/CF); riprap shall have no dimension greater than three (3) times its least dimension; recycled concrete shall be clean and contain no asphalt.

2. Filter fabric shall meet the requirements of Section 32.03 of this Chapter.

C. INSTALLATION

The area of the basin shall be excavated to a depth that will accommodate the basin thickness and shall be cleared of all vegetation, roots, and other objectionable material. The basin thickness, shape, and size shall be in accordance with Section 7.7 of the City of Lincoln Drainage Criteria Manual, as shown on the approved erosion and sediment control plan, and as directed by the Project Manager.

The filter fabric shall be placed over the entire excavated area. On both sides and at the tip end, the filter fabric shall be extended a minimum of six (6) inches past the basin edge, entrenched to a depth of four (4) inches and backfilled with compacted soil. At the bottom (outlet) end, the filter fabric shall extend a minimum of six (6) inches from the edge of the basin at finished ground level. The riprap shall then be spread evenly over the entire area of the basin and shaped accordingly. The riprap may or may not be grouted in place according to the approved erosion and sediment control plan or as directed by the Project Manager.

C. INSTALLATION (Continued)

For application, design, and construction details refer to Lincoln Standard Plan LSP-177 and Section 7.7 of the City of Lincoln Drainage Criteria Manual.

The riprap apron shall be constructed on the same day the storm drain outlet is constructed.

D. MAINTENANCE

The basin shall be inspected once every two (2) weeks, within twenty-four (24) hours after each rain event, daily during prolonged rain events and as directed by the Project Manager.

Any riprap and/or filter fabric that has been displaced or damaged in any way shall be re-laid or replaced within twenty-four (24) hours by the Contractor.

Maintenance shall not cease until the entire storm drain system is complete and is given final approval from the City.

E. MEASUREMENT AND PAYMENT

Installation of the riprap basin shall be paid for at the contract unit price per ton for "CULVERT OUTLET PROTECTION INST". This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating and placing all materials, and for all labor, tools, equipment and incidentals necessary to complete the installation work. The filter fabric and grout shall be subsidiary to the construction of the apron.

Maintenance shall be paid for at the contract unit price bid per each, per occurrence for "CULVERT OUTLET PROTECTION MAINT". This price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in Section 32.05.D above.

32.06 FILTER FABRIC STORM DRAIN INLET PROTECTION

A. GENERAL

Storm drainage inlet protection is a sediment filter or an excavated impounding area surrounding a storm drain drop inlet or curb inlet. Its purpose is to prevent sediment from entering storm drainage systems prior to permanent stabilization of the disturbed area.

B. MATERIALS

1. Geotextile filter fabric - Filter fabric material shall have a porosity (flow rate) as specified by the plan or directed by the Project Manager. Generally, low porosity fabric shall be used for inlet protection.

Fabric material shall have a minimum of one year of expected useable construction life at a temperature range of -18º to 49º Celsius.

Fabric material for inlet protection shall conform to the following specifications:

Fabric Properties	Requirements	Test Method
Grab Tensile Strength	0.5 kg/mm (Min.)	ASTM D 5034 and ASTM D 5035
Equivalent Opening Size	300 um sieve (Min.)	ASTM D 4751
Puncture Strength	36 kg (Min.)	ASTM D 751

The following products or their approved equivalent are considered to be acceptable for inlet protection.

Product	Manufacturer
Mirafi 100X	Mirafi Inc.
Terratex SC Propex Silt Stop 901	Webtech Inc.
	Amoco Synthetic Ind.

2. Posts and framing material - Wooden posts and framing boards shall have a cross sectional area of 5 1/4 square inches (standard 2" x 4") or larger. Metal posts shall be standard steel "T" post or approved equivalent.

C. INSTALLATION

Stakes shall be spaced evenly with a maximum spacing of three (3) feet around the entire perimeter of the inlet and are to be placed no closer than twelve (12) inches to the nearest face of the inlet. Stakes shall be securely driven into the ground to a minimum depth of twelve (12) inches for wooden stakes and sixteen (16) inches for metal stakes. Stakes shall extend a minimum of eighteen (18) inches above the ground for wooden stakes and twenty-four (24) inches 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 four (4) inches 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 six (6) inches and backfilled completely with compacted soil. Filter fabric shall be securely attached to the stakes and frames by staples or wire. The joint 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 the same day that the storm drain inlet is constructed.

For application, design, and construction details see City of Lincoln Standard LSP-178 and Section 9.6.4 of the City of Lincoln Drainage Criteria Manual.

D. MAINTENANCE AND REMOVAL

The structure shall be inspected once every two (2) weeks within twenty-four (24) hours after each rain even, daily during prolonged rain event, and as directed by the Project Manager.

Sediment deposits shall be removed when the level of deposition reaches one half (½) of the structure heights. Removed sediment shall be placed in a suitable location and in a manor that minimizes further erosion.

If, during required inspections, damage to the structure is observed the necessary repairs shall be completed within twenty-four (24) hours of the inspection.

The structure shall not be removed until the up slope area has been permanently stabilized. All materials shall be completed removed from the site and stored or disposed of properly.

E. MEASUREMENT AND PAYMENT

Installation shall be paid for at the contract unit price per each for “INST STORM DRAIN INLET PROTECTION”. This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating and placing all materials, and for all labor, tools, equipment and incidentals necessary to complete the installation work.

Maintenance shall be paid for at the contract unit price bid per each, per each occurrence for “STORM DRAIN 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 in Section 32.06.6 above.

Removal shall be paid for at the contract unit price bid per each for “REM STORM DRAIN INLET PROTECTION”. 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 removal work.

32.07 TURF REINFORCEMENT

A. GENERAL

Turf reinforcement should be used on seeded or planted areas of slopes, drainage channels, shorelines and any other area where vegetation growth and establishment may be compromised due to turf instability. Turf reinforcement may also be used in drainage channels as a permanent measure to increase stability and reduce erosion potential.

B. MATERIALS

1. Rolled turf reinforcement blankets shall consist of rolled blankets made of straw, jute, wood, or other approved organic plant fiber with cotton string or degradeable netting to hold the material in flat form.

2. Rolled turf reinforcement mats (TRM) shall consist of rolled three-dimensional polypropylene structure that may or may not be filled with coconut or other approved organic plant fiber.

3. Staples shall be No. 11 gauge or thicker and be at least two (2) inches wide and at least eleven (11) inches long.

C. INSTALLATION

The area to be reinforced shall be graded and shaped according to the approved grading plan or according to the Project Manager. The area shall be relatively free of clods or rocks larger than one and a half (1 ½) inches in diameter.

The area to be reinforced shall be fertilized and seeded according to the approved seeding/planting plan or according to the Project Manager.

On shallow slopes, less than 4H:1V, the blankets or mats may be installed parallel across the slope. On steep slopes, 4H:1V or greater, the blankets or mats shall be installed perpendicular down the slope. In ditches and drainage channels the blankets or mats shall be installed parallel to the direction of flow and in such a manner as to avoid seams along the channel bottom if at all possible. The blankets or mats shall be laid loosely and not stretched over the ground surface.

A six (6) inch wide section of the blanket or mat shall be entrenched a minimum of six (6) inches deep along the entire length of the top of slopes and at the upslope ends of channels and ditches. The trench shall then be backfilled with compacted soil over the top of the blanket or mat. The blanket or mat shall be extended a minimum of forty (40) inches back from the top of the slope or bank of the channel.

The blanket or mat shall be stapled at a maximum of three (3) foot intervals along all edges. Where multiple widths are installed side by side, the adjacent edges shall be overlapped a minimum of six (6) inches with the upslope edge laid on top of the down slope edge and stapled at a maximum of three (3) foot intervals along the entire seam.

For application, design, and installation details see City of Lincoln Standard Plan LSP-179.

D. MAINTENANCE

The blanket or mat shall be inspected once every seven (7) days, withing twenty-four (24) hours after each rain event, daily during a prolonged rain event and as directed by the Project Manager.

If, during required inspections, erosion or undermining beneath the blanket or mat is observed, the blanket or mat shall be pulled back and any lost soil shall be replaced and the area shall be reseeded. After reseeding the blanket or mat shall be reinstaled according to Section 32.06 C above. The maintenance shall be completed withing twenty-four (24) hours of the inspection.

E. MEASUREMENT AND PAYMENT

Turf reinforcement shall be paid for at the contract unit price per square foot (SF) for "TURF REINFORCEMENT". This price shall be full compensation for furnishing, preparing, transporting, delivering, excavating, and placing materials, and for all labor, tools, equipment and incidentals necessary to complete the installation and maintenance work.

32.08 TRIANGULAR SEDIMENT BARRIERS

A. GENERAL

Triangular sediment barriers operate 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 flow over the top. Triangular sediment barriers can be used as ditch checks, continuous sediment barriers, culvert inlet protection, and drop inlet protection.

B. MATERIALS

1. Triangular sediment barriers shall be triangular in shape, having a height of at least nine (9) inches in the center with equal sides and at least a sixteen (16) inch 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 thirty (30) inches. Standard length of each barrier will be seven (7) feet unless otherwise indicated on the plans.

2. Staples shall be No. 11 gauge wire and be at least eight (8) inches long.

C. INSTALLATION

Triangular sediment barriers shall be installed in locations and configuration as shown on the approved erosion and sediment control plan or as directed by the Project Manager.

A four (4) inch wide by four (4) inch 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.

C. INSTALLATION (Continued)

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 four (4) to six (6) inches of the upstream apron in the trench and anchor it with one row of staples on eighteen (18) inch centers at the bottom of the trench angled slightly toward the downstream side. Place an additional row of staples on eighteen (18) inch 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 eighteen (18) inch 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.

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.

For application and design details see the City of Lincoln Standard Plan LSP 180.

D. MAINTENANCE AND REMOVAL

The structure shall be inspected once every two (2) weeks, within twenty-four (24) hours after each rain event, daily during a prolonged rain event, and as directed by the Project Manager.

Sediment deposits shall be removed when the level of deposition reaches one half (½) of the structure height. Removed sediment shall be placed in a suitable location and in a manor that minimizes further erosion.

If, during required inspections, damage to the structure is observed the necessary repairs shall be completed within twenty-four (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. MEASUREMENT AND PAYMENT

Installation shall be paid for at the contract unit price per linear foot (LF) for “INST TRIANGULER SEDIMENT BARRIER”. 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 installation work.

Maintenance shall be paid for at the contract unit price bid per linear foot (LF) for “TRIANGULAR SEDIMENT BARRIER MAINT”. this price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in Section 32.08.D above.

Removal shall be paid for at the contract unit price bid per linear foot (LF) for “REM TRIANGULAR SEDIMENT BARRIER”. 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 removal work.

32.09 STRAW BALE DIKES

A. Straw bale dikes are temporary sediment barriers consisting of a row of entrenched and anchored straw bales. Straw bale barriers shall be used for detaining small amounts of sediment and decreasing flow velocities.

B. MATERIALS

1. Straw bale dikes are temporary sediment barriers consisting of a row of entrenched and anchored straw bales. Straw bale barriers shall be used for detaining small amounts of sediment and decreasing flow velocities.

2. Posts shall be standard steel “T” posts or approved equivalent.

C. INSTALLATION

Straw bales shall be placed end to end entrenched a minimum of four (4) inches below the ground surface. Loose straw shall be packed into any spaces between straw bales. The bales shall be placed such that the bale ties are oriented around the sides of the straw bales, not the top and bottom, so as to minimize the deterioration of the bale ties.

Each straw bale shall be anchored to the ground by two (2) wooden or steel posts. The posts shall be located approximately six (6) inches from each end of the straw bale on center. The posts shall be driven a minimum of twelve (12) inches into the ground and shall be flush with the top of the straw bale.

Soil shall be backfilled and compacted around the base of the straw bale barrier.

Straw bale dikes shall be constructed prior to or the same day that land disturbance activities are performed up slope of the straw bale dikes.

For design details see City of Lincoln Standard Plan LSP 181 and Section 9.6.3 of the City of Lincoln Drainage Critieria Manual.

D. MAINTENANCE AND REMOVAL

The structure shall be inspected once every two (2) weeks, within twenty-four (24) hours after each rain event, daily during a prolonged rain event, and as directed by the Project Manager.

Sediment deposits shall be removed when the level of deposition reaches one half (½) of the structure height. Removed sediment shall be placed in a suitable location and in a manor that minimizes further erosion.

If, during required inspections, damage to the structure is observed the necessary repairs shall be completed within twenty-four (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. MEASUREMENT AND PAYMENT

Installation shall be paid for at the contract unit price per each for “STRAW BALE DIKE 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 installation work.

Maintenance shall be paid for at the contract unit price bid per each for “STRAW BALE DIKE MAINT”. this price shall be full compensation for any and all labor, tools, equipment, and incidentals necessary to complete the maintenance activities listed in Section 32.09.D above.

Removal shall be paid for at the contract unit price bid per each for “STRAW BALE DIKE 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 removal work.

CITY OF LINCOLN NEBRASKA, STANDARD SPECIFICATIONS

Chapter 33

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CHAPTER 33
IRRIGATION WORK

33.00 DESCRIPTION

A. 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.

B. 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 accordance with City of Lincoln Standard Plans, Special Provisions, and these Specifications.

C. This work shall consist of furnishing, delivering and installation of all irrigation material and all operations incidental thereto, in accordance with these Specifications and the Special Provisions, including the following:

1 . The regulation and adjustment of all sprinkler heads, timed sequence control devices, sectional valves, rain overider, 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 overrider, 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:

1. National Fire Protection Association (NFPA); National Electrical Code

2. American Society for Testing and Materials (ASTM)

3. National Sanitation Foundation (NSF)

4. The Irrigation Association (IA)

C. GENERAL IRRIGATION REQUIREMENTS - Work shall be performed in accordance 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 specifications appropriate for the project.

1. Coordinate 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 DRAWINGS

1. It is intended that the Design represented by the Drawings and Specifications specify an efficient and complete irrigation system for use in accordance with the Manufacturer's recommendations and meeting the City's Engineer, Landscape Architect or Representative's approval.

2. 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 drawings.

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 representative. This drawing shall include a hard copy and 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, 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 manufacture'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:

33.02 MATERIALS (Continued)

Rain Bird

Or equal, if and specifically approved by the the City's Engineer, Landscape Architect or Representative by addendum during the bidding period.

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 hainv a minimum working pressure rating of Class 200 or Schedule 40. All PVC pipe shall be continuously and permanently marked with the manufactuer'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 leakproof 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

Standard PVC nipple

F. GATE VALVES

Manufactureres standard of type and size required bass construction conforming to A.W.W.A. Specifications.

G. DRAIN VALVES

Manufacturer's stand of type and size required.

½" Model AFD-0500 antifreeze drain valve manufactured by Kbi or equal, if and as specifically approved by the City's Engineer, Landscape Architect or Representative during the bidding period.

H. REMOTE CONTROL VALVES

Manufacturers standard of type and size required.

33.02 MATERIALS (Continued)

All valves will be located in valve boxes 10 inch minium, plastic construction as manufactured by Amtek Corp. Valve box shall be vandal resistant. Lift off lids are not acceptable.

I. BACKFLOW PREVENTER

Brass construction conforming to City of Lincoln Standard Requirements for turf irrigation systems. Building and Safety recognize two (2) devices appropriate for irrigation systems:

1. Reduced Pressure (RP) principle backflow preventer.

2. Pressurized Vaccum 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. Minium size shall be 14 gauge, solid single conductor, copper.

Provide 10" expansion coil at each valve and at 100 intervals.

K. AUTOMATIC CONTROLLERS

Automatic controller shall be a Hunter ICC-800M 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 accordance 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 drawings.

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.

N. WIRELESS VALVE SYSTEM

Must include a fully submersible batter-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 feet, 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 be 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 expoxy 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 in12" 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 one (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 DBBY connectors.

R. COPPER TRACER WIRE

Copper tracer wire should be installed with all piping so that the system made be 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.

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 Engineer, Landscape Architect or Representative prior to installation.

U. QUICK COUPLER VALVES

1. All quick couplers shall be of 5RC body, 55K key and an SH1 swivel 1" shaft x 1" MPT x 3/4" hose thread.

2. Quick coupling valves shall be located within a weather resistant plastic valve box 6 inch minium, with lockable lid. Do not locate within paved surfaces.

3. Fill: Clean soil free fo stones larger than 2" diameter, foreign matter, organic matter and debris. Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials. Suitable excavated materials removed to accommodate the irrigation system work may be used as fill.

4. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3" maximum to 3/4" minimum.

5. Locate within valve box 4" deep layer of coarse gravel beneath the bottom of the valve.

6. Copper Wire: #12 awg copper wire with National Electrical Code type THHN/THWN insulation.

7. Top of quick coupler valves shall be as close to the top of valve box as possible.

V. BACKFLOW ENCLOSURE

1. The backflow device shall have a steel locking vandalism resistant enclosure approved by the City's Engineer or representative.

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.

C. LOCATION OF SPRINKLER HEADS

Except for roadway 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, roadways, 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.

33.03 SYSTEM DESIGN (Continued)

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 2" in 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 tenches 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

1. The irrigation work shall be scheduled by the Irrigation Contractor in such a way that existing underground utilities are protected.

2. 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 Engineer, Landscape Architect or Representative adequate notice to visit the site and perform the inspection. This does note preclude the right of the City's Engineer, Landscape Architect, or Representative to make informal inspection at any time during the work of this section. The required inspection for which the Irrigation Contractor must notify the City's Engineer, Landscape Architect or Representative are as follows:

1. UTILITY AND IRRIGATION EQUIPMENT LOCATION STAKING

The City's representative or assigns shall inspect the proposed locations of all Irrigation lines and heads for conformance to the Drawings and Specifications. The City's representative 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 Drawings.

2. WIRING INSPECTION

When the wiring has been installed, the City's Engineer, Landscape Architect or Representative shall inspect for conformance to these Drawings 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 representative, shall perform a coverage test to determine if the irrigation system reaches all parts of the areas to be sodded.

33.04 INSTALLATION (Continued)

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 representative's observation. Contact the City's representative, in advance, and request inspection of the layout. The City's representative will observe layout and indicate any changes as needed.

C. TRENCHING/HORIZONTAL BORING

1. General: Excavate straight and true with bottom uniformly sloped to low points

2. Minium Cover: Provide the following minium cover over top of installed piping:

A. Mainline, 18" minimum

B. Lateral Lines, 12" minimum

C. Piping under pavement, 24" minimum

D. Sleeves, 18" minimum

3. BACKFILL: Backfill 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 waster materials as the backfilling progresses and shall be left in a neat and workmanlike condition.

4. EXISTING LAWNS: Where trenching is required across existing lawns, uniformly cut strips of sod 6" wider than the trench. Remove sod in rolls of suitable size for handling and keep moistened until replanted or replaced.

A. Backfill trench to within 6" of finished grade. Continue fill with acceptable topsoil and compact to bring sod even with the existing lawn.

B. Replant sod within (7) days after removal, roll and water generously.

C. 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 side. Install minimum 12" above highest ground level sprinkler head.

33.04 INSTALLATION (Continued)

E. CIRCUIT VALVES

Install in accordance 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 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.

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 provision of these Specifications exceed such requirements, these specifications shall govern. All plastic pipe shall be installed in a manner so as to provide for expansion and contraction as recommend by the Manufacturer.

2. SOLVENT-WELD PIPE AND FITTINGS

Install pip in dry weather when temperature is above 40 degrees F and in accordance 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 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. Prime 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 quarter (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 fifteen (15) 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 twenty-four (24) hours before pressure is applied to the system at a temperature above 40 degrees F.

33.04 INSTALLATION (Continued)

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 two inches 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.

G CONTROL WIRING

1. 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 one (1) central location, in a valve box, if possible. All field splices shall be installed in a 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 representative. 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 wire connectors and sealing cement in accordance with manufacturer's recommendation.

J. VALVE BOXES

Control valve boxes shall be installed on a minimum of one (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 two (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 pints the branch piping and in the main at intervals not to exceed 200 feet of pipe.

L. SPRINKLER HEADS

Unless otherwise specifically designated on the Drawings, the installation of irrigation heads shall include the excavation and backfill, furnishing, installing and testing of risers, fittings and irrigation heads in accordance with the Drawings and Specifications. Pop-up spray irrigation heads shall be installed with 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.

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 his assigns shall be continue to be responsible for properly making any additional adjustments during the maintenance period.

Tighten nozzles on spray type sprinklers after installation. Adjust sprinklers adjusting screw lateral line or circuit s required for proper radius. Interchange nozzles patterns to provide the best arc of coverage.

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 complete 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 and neat.

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, he shall notify the Architects representative that he is prepared for Final Inspection. At the given time, the sprinkler system will be inspected by the architect's representative for the following:

A. SPRINKLER HEADS
   1. Heads adjusted to grade.
   2. Heads properly aligned.
   3. Nozzles properly adjusted.
   4. Broken heads replaced.
   5. Missing heads replaces (stolen or otherwise).
   6. Broken risers replaced.
   7. Gate valves and control valves operation properly and not leaking.
   8. Controller operating properly and programmed.
   9. Any inconsistencies to the Specification will be noted by the Architects's

representative and a written copy of corrections will be given to the Irrigation Contractor. The City's representative will not accept. The system until the corrections from the final inspection have been made by the Irrigation Contractor.

33.08 MAINTENANCE

The maintenance of the irrigation system once installed needs to be provided including:

A. 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.

B. A schedule for (1) year of maintenance must be submitted for review by the City's representative, agreed upon and followed by the contractor.

C. 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.

A. 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 Engineer, Landscape Architect or representative.

B. The water schedule must be assigned to an appointed and qualified employee or outsourced to a private company.

C. The watering schedule must be created around the anticipated water requirements of the plant material.

33.10 REPLACEMENTS AND GUARANTEE

The new irrigation system workmanship and materials shall be guaranteed for the period of one (1) year from the date of acceptance of work. The irrigation contractor shall be responsible for proper winterization of the irrigation system during the one (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 QUALIFICATION 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 following requirements be established:

A. The contractor performing the work must be a certified irrigation contractor and fully insured and licensed.

B. The contractor performing the work must be able to demonstrate a minimum work experience record.

C. The contractor performing the work must have successfully completed projects similar in scope and scale.

33.12 REQUIREMENTS FOR SUBMITTING BIDS

All bids submitted must include the following information on the **BID PROPOSAL:**

The item of Irrigation system shall be measured as a Lump Sum item, including, boring, materials, labor, and incidental operations as called for in these specifications, and shall be listed on the bid PROPOSAL. Materials as specified on the bid PROPOSAL which cannot be furnished, delivered and installed should be noted in writing as “not available” on the bid PROPOSAL form.

All bid prices shall be firm and shall include all necessary labor, materials and equipment required as specified within these specifications.

Bids submitted shall conform to the contract forms and the specific requirements of these specifications.

Payment for Irrigation System is on a Lump sum basis in accordance with the general conditions of the City of Lincoln Standards and specifications. The price shall be full compensations for furnishing and installation all materials, equipment and incidentals necessary to complete the work as specified here in.

If sidewalk, street or curb removal and replacement is required, it will be determined to be incidental to Irrigation System, and separate payment will not be made.

After award of contract: Prior to construction, submit manufacturer’s product data on each type of irrigation product. Two copies of bound Product data shall be submitted with other Submittal required for the contract.

Submit manufacturer’s product date 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.