

City of Rapid City



Standard Specifications

for

Public Works Construction

2007 Edition

Specification Change Summary
2007 Edition
Rapid City Standard Specification
May 2007

The 2007 edition of the standard City specification has been created to update earlier versions of the standard specification. Certain sections have remained the same as earlier versions, some have changed in a minor way, and some have undergone major changes.

In order to assist the user, the following listing is a summary of the subjective extent of change in the various sections from the 2004 version of the specification. If change has occurred in a section, the user is strongly advised to study the section to become familiar with the extent of the change. Although the summary attempts to categorize the change as none, minor or major, the user must determine whether even a minor change affects their work. Not all changes are identified in the "Remarks" column of this summary.

Section number and title	extent of change	Remarks
007 – General Conditions	none	
008 – Water Piping Systems	major	changes throughout
009 – Sanitary Sewer	major	changes throughout
010 – Earthwork – Cleaning and Grubbing	minor	see 10.3
011 – Utility Excavation & Backfill	minor	see 11.3.B.4. b & c
012 – Roadway & drainage Excavation	minor	see 12.3.E
013 – Removal Items	minor	see 13.3.C
014 – Embankment	minor	see 14.3 F
015 – Disposal of Surplus Excavation & Waste	minor	see 15.3
016 – Optioned Borrow Excavation	minor	
017 – Salvage, Stockpiling, and Placing Topsoil	minor	see 17.3 A & D
018 – Erosion and Water Pollution Control	minor	
019 – Incidental Work	none	
020 – Granular Materials	minor	see 20.3.E
031 – Asphalt Concrete – General	major	see 31.3.A; B.1 & F
032 – Asphalt Concrete – Class E	minor	
033 – Asphalt Concrete – Class G	minor	

034 – Asphalt Concrete – Class S	minor	
035 – Prime, Tack, and Flush Seal Coats	none	
036 – Cold Asphalt Planing	none	
037 – Asphalt Surface Treatment	none	
039 – Cold Mix Asphalt	minor	
040 – Portland Cement Concrete Pavement	minor	
041 – Utility Trench Resurfacing	minor	
051 – Structural Excavation for Box Culverts	minor	
052 – Box, pipe, and Plate Culvert Undercutting	none	
053 – Drainage Fabric for Reinforced Concrete Box Culverts	minor	
054 – Pipe Culverts	major	see 54.3.F & G
055 – Concrete Masonry	minor	see 55.3.L
056 – Concrete for Incidental Construction (Class M)	minor	
057 – Reinforcement for Concrete Masonry	none	
058 – Precast Concrete Concrete Box Culvert	major	see 58.3.D
059 – Steel Beam Guard Rail	minor	
060 – Concrete Curb and Gutter	minor	
061 – Concrete Sidewalk, Handicapped Ramps and Detectable/Tactile Warning Surfaces	minor	see 61.2.G & 61.3.C
062 – Drop- Inlets	major	see 62.2.C & 62.3
063 – Storm Sewer Manholes	minor	
064 – Underdrains	minor	see 64.2 & 64.3
065 – Riprap	none	
066 – Slope Protection	minor	
067 – Fabric Formed Concrete Mat	minor	
068 – Bank and Channel Protection	none	
069 – Bank Protection Gabions	none	

070 – Seeding	minor	70.3.A; 70.3.C.1 & 70.3.C.2
071 – Fertilizing	minor	
072 – Mulching	minor	see 72.3.A.1 & 72.3.D
073 – Sodding	minor	
074 – Planting Trees, Shrubs, and Vines	minor	see 74.3.F.1.b & 74.3.F.7
075 – Transplanting Trees and Shrubs	minor	
076 – Compost Application	major	new section
090 – Traffic Control	minor	see 90.2
091 – Traffic Control Devices	minor	see 91.4 & 91.5
092 – Traffic Signs and Roadway Lighting	major	see section
093 – Pavement Markings and Permanent Signage	minor	see 93.1.A; 93.2.D & 92.3.E
100 – Portland Cement	minor	
101 – Air-Entraining Admixtures	minor	
102 – Chemical Admixtures for Concrete	minor	
104 – Water for use in Portland Cement Concrete	none	
105 – Fine Aggregate for use in Portland Cement Concrete	none	
106 – Masonry Sand & Epoxy Resin Mortar Sand	minor	see 106.1.C.2
107 – Course Aggregate for use in Portland Cement Concrete	minor	
108 – Concrete Curing Materials	minor	see 108.1.D.1.a
109 – Riprap and Slope Materials	none	
111 – Crushed Aggregate for Maintenance	none	
112 – Select Granular Backfill	minor	112.2.D
113 – Preformed Expansion Joint Filler	none	
114 – Concrete Joint Sealer	minor	
115 – Aggregates for Asphalt Concrete	none	
116 – Aggregates for Asphalt Surface Treatments	minor	

117 – Aggregates for Granular Bases and Surfacing	minor	
118 – Asphalt Material	none	
120 – Reinforced Concrete Pipe	minor	
121 – Corrugated Metal Pipe	minor	
123 – Reinforcement	none	
124 – Fabric Formed Concrete Mat Material	none	
125 – Gabions	none	
126 – Wood Preservatives and Preservative Materials	none	
145 – Bridge Repainting	none	
146 – Erosion Treatment Material	major	see section
190 – Watering	minor	see 190.3
200 – Low Strength Material (Flowable Fill)	minor	see 200.2.D
201 – Construction Stakes, Lines, Grades	minor	
202 – Engineering Fabric	none	

The specification user is also cautioned to carefully review all standard details as many have changed to reflect the changes in the standard specification.

**REQUEST TO REVISE THE CITY OF RAPID CITY
STANDARD SPECIFICATIONS FOR PUBLIC WORKS
CONSTRUCTION**

Please submit this form or a document with the following information to request a change to the "City of Rapid City Standard Specifications for Public Works Construction". The City of Rapid City will consider each request in its annual specification review process. Please be as specific as possible for each request. Proposed wording and supporting documentation for the proposed specification change will increase the chances for approval.

Requestor's Name:

Address:

Telephone Number:

E-mail Address:

Specification Section Proposed for Change: _____
(Please submit individual forms for each specification section proposed to be changed)

General description of proposed change:

Specific Wording for Proposed Specification Section Change:

Supporting documentation for proposed change such as AWWA Standard, SDDOT Standard, etc.

Does this proposed change impact or require changes to other specification sections or details:

____ Yes ____ No

If yes, which sections are impacted?

Submit Request to:

Proposed Specification Revision
City of Rapid City
Engineering Services
300 Sixth Street
Rapid City, SD 57701

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13.	Removal Items
14.	Embankment
15.	Disposal of Surplus Excavation and Waste
16.	Optioned Borrow Excavation
17.	Salvaging, Stockpiling, and Placing Topsoil
18.	Erosion and Water Pollution Control
19.	Incidental Work
20.	Granular Materials
31.	Asphalt Concrete – General
32.	Asphalt Concrete - Class E
33.	Asphalt Concrete - Class G
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35.	Prime, Tack, and Flush Seal Coats
36.	Cold Pavement Planing
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SECTION 7

GENERAL CONDITIONS

7.1 DEFINITIONS AND TERMS

That whenever any word or expression defined herein, or pronoun used in its stead, occurs in these specifications or other Contract documents, it shall have and is mutually understood to have the meaning herein given:

- A. "Addendum" or "Addenda" shall mean a change or changes to the bid proposal documents issued by the City of Rapid City prior to the time of opening of the proposals.
- B. "Advertisement" shall mean the public announcement inviting bids for work to be performed or materials to be provided.
- C. "Award" shall mean the acceptance of a bid proposal by the City of Rapid City Council.
- D. "Bidder" shall mean the individual, partnership, firm, corporation, or an acceptable combination thereof, such as a joint venture that is submitting a proposal.
- E. "Bid Proposal", "Bid" or "Proposal" shall mean the written offer of a bidder, on the prescribed form, to perform the work at the prices quoted.
- F. "Bid Schedule" shall mean the list of bid items, together with estimated quantities appearing in the proposal form.
- G. "Calendar Day(s)," unless herein otherwise expressly defined, shall mean a day or days of twenty-four hours each, beginning and ending at midnight.
- H. "Change Order" shall mean a written order issued by the Engineer to the Contractor, covering changes in the plans, specifications, or quantities within the scope of the Contract and establishing the basis of payment and time adjustments for the work affected by the changes.
- I. "Contract" or "Contract Documents" shall mean the written agreement between the Owner and the Contractor setting forth the obligations of the parties for the performance of the prescribed work.

The Contract shall include: Notice for Bids; Instructions to Bidders; Bid Proposal; Contract Form and Contract Bond; Notices; Insurance; Performance Bond; Special Conditions; General Conditions; Special Provisions; Standard Specifications;

Detailed Specifications; Standard Drawings; Detailed Plans; Plans Drawings; Addendum; Change Orders; and agreements that are required to complete construction of the work, all of which constitute one instrument.

Detailed plans and/or specifications that are furnished by the Contractor to clarify or define the Owners contract must be approved by the Engineer prior to use. Upon approval, said plans and/or specifications shall be considered a part of this Contract.

- J. "Contract Item", "Bid Item" or "Pay Item" shall mean a specific unit of work for which a price is provide in the Contract.
- K. "Contract Performance Bond" shall mean the security executed by the Contractor and furnished to the Owner to guarantee performance of the work in accordance with the Contract.
- L. "Contract Time" or "Contract Days" shall mean the number of working days allowed for performance and completion of the Contract or date work is to be completed, as stated in the Proposal and Contract.
- M. "Contractor", "Prime Contractor" or the words "Party of the Second Part" shall mean the individual, partnership, firm, corporation, or joint venture contracting with the City of Rapid City for performance of the prescribed work covered by the Contract and his duly authorized agents or legal representatives.
- N. "Contract Date" or words equivalent thereto, shall mean the date upon which this Contract, executed by the Contractor, is signed by the Owner.
- O. "Delay" shall mean an increase in the time required for completion of the contract work beyond that originally contemplated by the parties at the time the Contract was signed.
- P. "Excusable Delay" shall mean unforeseeable delay, which excuses the Contractor's obligation to complete the work on time by extending performance time for contractually specified reasons.
- Q. "Inexcusable Delay" shall mean delay for which the Contractor is not entitled to a time extension or monetary compensation and may even be liable in damages to the Owner.
- R. "Compensable Delay" shall mean delay for which the Owner is liable in damages to the Contractor. Compensable delay is a subcategory of excusable delay, since all compensable delays will also be excusable delays. However, not all excusable delay is compensable.
- S. "Engineer" shall mean the Director of Public Works, who has been employed by the Owner for this work, acting directly or through his duly authorized agents, such agents acting severally within the scope of the particular duties entrusted to them, responsible for engineering inspection of the Contract work.

- T. "Equipment" shall mean any machinery, tools, implements or apparatus together with supplies for maintenance and upkeep, necessary for the construction and completion of the Contract work.
- U. "Extra Work" shall mean an item of work not provided for in the Contract as awarded, but found by the Engineer to be essential to the satisfactory completion of the Contract within its intended scope.
- V. "Holiday" shall mean the first day of January, commonly known as New Year's Day; the Friday immediately preceding Easter, commonly known as Good Friday; the last Monday in May, commonly known as Memorial Day; the fourth day of July, commonly known as Independence Day; the first Monday in September, commonly known as Labor Day; the eleventh day of November, commonly known as Veteran's Day; the fourth Thursday in November, commonly known as Thanksgiving Day; the Friday immediately following Thanksgiving Day; the twenty-fifth of December, commonly known as Christmas Day; and any other day declared by the City to be a holiday.
- If the day of observance of the foregoing holidays is changed by enacted laws of the State of South Dakota, such day will be the day of observance of such holiday. Whenever any of the foregoing holidays fall on Sunday, the Monday immediately following shall also be observed as a holiday. Whenever any of the foregoing holidays fall on Saturday, the Friday immediately preceding shall also be observed as a holiday. Saturdays and Sundays will be considered the same as Holidays.
- W. "Incidental Items" or "Incidental Work" shall mean items of work, as shown on the plans and/or in the specifications, for which there are no bid items in the Bidder's Proposal. If no bid item for "Incidental Work" is included in the bid proposal, the cost of these items shall be included in the contract bid price for related work items.
- If a bid item for "Incidental Work" is included in the bid proposal, such work shall be included as a part of this work item.
- X. "Inspector" shall mean the engineer's authorized representative or representatives assigned to make detailed inspections of contract performance, limited to the particular duties entrusted to them.
- Z. "Owner", "City", "City of Rapid City", or "Party of the First Part" shall mean the City of Rapid City acting through its authorized representatives.
- AA. "Materials" shall mean substances specified for use in the construction of the project.
- AB. "Notice to Proceed" shall mean the written authorization to begin work on the project.
- AC. The "Plans" shall mean the Contract drawings which show the location, character, and dimensions of the prescribed work, including layouts, profiles, cross sections, and all drawings submitted by the successful bidder with his Proposal and by the

Contractor to the Owner, if and when approved by the Engineer; and all drawings submitted by the Owner to the Contractor during the progress of the work, as provided for herein.

- AD. "Project" shall mean the specific section of street, road, property together with all appurtenances and construction to be performed under the Contract.
- AE. "Provide" shall be interpreted to mean both furnish and install.
- AF. "Special Provisions" shall mean additions and revisions to the standard and supplemental specifications applicable to the individual project.
- AG. "Specialty Items" shall mean those items of work specified in the proposal requiring special equipment, materials, or skills not normally required in typical construction work.
- AH. "Specifications" is a general term applied to all directions, provisions, and requirements pertaining to performance of the work.
- AI. "Standard Specifications" is the book of specifications approved by the Owner for general applications and repetitive use.
- AJ. "Subcontractor" shall mean an individual, partnership, firm, corporation, or joint venture, to which the Contractor sublets a portion of the Contract.
- AK. "Submittals" shall include all drawings, diagrams, descriptive literature, illustrations, instructions, schedules, safety plans, operating plans, performance and test data, product data sheets, material safety data sheets, and similar materials prepared by the Contractor or a supplier to illustrate material or equipment or some portion of the work.
- AL. "Substantial Completion" shall mean: a) the Contractor is prosecuting the remaining work in a manner satisfactory to the Engineer; b) the project is or could be used for the purposes intended; and c) pedestrian or vehicular traffic will not be inconvenienced by prosecution of the remaining work.
- AM. "Superintendent" shall mean the Contractor's authorized representative in responsible charge of all of the Contract work.
- AN. "Supplemental Specifications" shall mean approved additions and revisions to the Standard Specifications.
- AO. "Work" shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary to the successful completion of the project.
- AP. "Working Day" shall mean a calendar day, other than holidays or Sundays, except as permitted in writing by the Engineer, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for

at least five (5) hours, with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

- AQ. "Written Notice" shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered mail to the last business address known to him who gives the notice.

That whenever in these Contract documents the words "as ordered," "as directed," "as required," "as permitted," "as allowed," or words or phrases of like import are used, it shall be understood that the order, direction, requirements, permission, or allowance of the Owner and the Engineer is intended.

Similarly, the words "approve," "reasonable," "suitable," or "acceptable," otherwise particularly specified herein, shall mean approved, reasonable, suitable, acceptable, proper, or satisfactory in the judgment of the Owner and Engineer.

7.2 ABBREVIATIONS

Whenever the following abbreviations are used in these specifications or on other Contract Documents, they are to be construed the same as the respective expressions and to mean the code or standard that is in effect at the date of advertisement for bids:

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ARA	American Railway Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWWA	American Water Works Association
AWS	American Welding Society
FHWA	Federal Highway Association
FAA	Federal Aviation Administration
FSS	Federal Specifications and Standards
GSA	General Services Administration
ICC	Interstate Commerce Commission
IPECA	Insulated Power Cable Engineer's Association
ITE	Institute of Transportation Engineers
MUTCD	Manual of Uniform Traffic Control Devices

NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
RETMA	Radio Electronic Television Manufacturer's Association
SAE	Society of Automotive Engineers
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratory

7.3 SUBHEADINGS AND TITLES

The titles or subheadings used in this contract and on the contract plans and drawings and in the specifications, are understood to be for convenience of reference only, and shall not be taken or considered as being a part thereof, or as having any bearing on the interpretation thereof.

7.4 NATURE AND LOCATION OF WORK

It is understood and agreed that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character of equipment and facilities needed preliminary to and during the execution of the work, the general and local conditions, and all other matters which can in any way affect the work under this Contract.

7.5 VERBAL STATEMENTS NOT BINDING

It is understood and agreed that the written terms and provisions of the Contract Documents shall supersede all verbal statements of the Engineer or other representatives of the City, and such statements shall not be effective or be construed as entering into, or forming a part of, or altering in any way whatsoever the written Contract.

7.6 SCOPE, NATURE, AND INTENT OF CONTRACT PLANS AND SPECIFICATIONS

The Contractor shall, in good and first-class workmanlike manner, and at his own cost and expense, furnish all of the labor, tools, materials, and equipment necessary to complete, ready for use, all of the work as designated and as described by the Contract Documents on file with the Finance Officer of the City of Rapid City, Rapid City, South Dakota.

The said specifications, plans, and contract are intended to supplement, but not necessarily duplicate, each other and together constitute one complete set, so that any work covered in the one and not in the other shall be executed just as if it had been set forth in the Contract, in order that the work shall be completed according to the complete design or designs as decided and determined by the Engineer. It is understood and

agreed that the work shall be performed and completed according to the true spirit, meaning, and intent, of the contract and specifications.

The Contractor agrees that in undertaking to complete the work within the time herein fixed, he has taken into consideration and made allowances for all of the ordinary delays and hindrances incidental to such work, whether or not growing out of delays in securing materials or equipment. Compensation for delays due to no fault of the Contractor may be negotiated.

The Contractor also agrees that all time limits stated in the Contract Documents are of the essence of the Contract.

All the work shall be done under the direct observation of the Engineer and to the entire satisfaction of the Engineer and the Owner and in accordance with the laws of the State of South Dakota and the Ordinances and Codes of the City of Rapid City.

7.7 DUTIES AND POWERS OF INSPECTORS

Properly authorized inspectors shall be considered to be the representatives of the Engineer, limited to the duties and powers entrusted to him. It shall be their duty to inspect the materials and workmanship of those portions of the work to which they are assigned, either individually or collectively, under instructions of the Engineer and to report any and all deviations from the plans, specifications, and other contract provisions which may come to their notice. Any Inspector shall have the right to order the work entrusted to his supervision stopped if in his opinion such action becomes necessary, until the Engineer is notified and he has determined and ordered that the work shall proceed in due fulfillment of all contract requirements. The Engineer and his representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

7.8 SEPARATE CONTRACTS

The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs.

If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such work that render it unsuitable for such proper execution and results. His failure so to inspect and report shall constitute an acceptance of the other contractors work as fit and proper for the reception of his work, except as to defects which may develop in the other contractors work after the execution of his work.

To insure the proper execution of his subsequent work, the Contractor shall measure work already in place and shall at once report to the Engineer any discrepancy between the executed work and the Drawings.

7.9 CONTRACT EXECUTION

The Bidder agrees that he will execute the contract in accordance with the proposal as accepted and secure and furnish the required bonds and insurance within ten (10) calendar days from the date of mailing of said notice of bid award to him at his address as given on the proposal or within such additional time as may be allowed by the Engineer; and that, upon his failure or refusal to do so within said time, the certified or cashier's check or bidder's bond accompanying this bid and the money payable thereon shall be forfeited to and become the property of the City of Rapid City as liquidated damages for such failure or refusal.

7.10 COPIES OF CONTRACT

Not less than four (4) copies (and as many more as may be required) of the bound volumes of the proposal, contract, and specifications shall be prepared, each shall contain an exact copy of the Contract signed by both parties thereto. Two (2) executed copies shall be filed with the City. Additional copies shall be filed where and as may be required.

7.11 RESPONSIBILITY OF CONTRACTOR

General Responsibility: The Contractor shall furnish all transportation, ways, works, machinery, and plant, and all suitable appliances required for the safe, proper, and lawful construction, maintenance, and use thereof. The Contractor shall be fully responsible for the materials and equipment used for the work and for safeguarding the work against damage or destruction until its final acceptance by the Engineer. The Contractor agrees to make no claims for damage to the work prior to final acceptance and will make no claims for damage to the materials except through negligence or willful act of the Owner.

Before the completion and acceptance of this Contract shall be made good by him, he shall be solely answerable for all damage to the Owner or the property of the Owner; to other Contractors, or other employees of the Owner; to the neighboring premises or to any private or personal property due to improper, illegal, or negligent conduct of himself or his subcontractors; employees or agents in and about said work or in the execution of the work covered by this Contract or any extra work undertaken herein provided; or to any defect in, or the improper use of, any scaffolding, shoring, apparatus, ways, works, machinery or plant. He shall indemnify and save harmless the Owner and its officers and agents from all claims relating to labor, materials, and methods used in executing the work.

7.12 PERSONS IN RESPONSIBLE CHARGE

The Contractor shall have on the site at all times a superintendent or a person in his employ who shall be in responsible charge of all work. The Contractor shall, in writing, give the Engineer the name of the person in responsible charge prior to beginning any work. Changes of persons in responsible charge during the course of performing the work shall be submitted, in writing, to the Engineer prior to instituting the change.

7.13 ORDER OF COMPLETION OF WORK

The Contractor shall, within ten (10) days after being instructed to do so in a written notice from the Engineer, commence the work to be done under this contract; and the rate of progress shall be such that work shall have been completed in accordance with the terms of this Contract, on or before the date of completion named in the proposal hereof.

7.14 CONTRACTOR TO CHECK SPECIFICATIONS AND SCHEDULE

The Contractor shall check all specifications, quantities, and schedules given to him by the Engineer and shall, upon discovery, notify the Engineer in writing of any discrepancy which he may discover between the plans and specifications or between either plans and specifications and physical site conditions; or if he observes site conditions not usually encountered on this type of work; or if he believes the plans and specifications require work which would violate laws, ordinances, or codes. Failure to follow this procedure shall preclude the Contractor from making any claim for damages resulting from the alleged discrepancy.

Should anything be omitted from the specifications, plans, and/or contract which is necessary to the clear understanding of the work, or should it appear various instructions are in conflict, then the Contractor shall secure written instructions from the Engineer before proceeding with the construction affected by such omissions or discrepancies. Failure to request written instructions shall constitute a waiver to any and all claims associated with the omission or conflict.

The Contractor will not be allowed to take advantage of any error or omission in the plans, specifications or contract documents, as full written instructions will be furnished by the Engineer, should such error or omission be discovered, and the Contractor shall carry out such instructions as if originally specified.

7.15 CALCULATED DIMENSIONS TO GOVERN

In case of discrepancy, calculated dimensions will govern over scaled dimensions.

7.16 DRAWINGS FURNISHED BY CONTRACTOR

The Contractor shall supply such working specifications and drawings of devices, castings and composite materials to be furnished under this Contract as are called for herein or are required by the Engineer to make clear the details of equipment and of devices.

7.17 PATENTS

It is further agreed that all royalties for patents or patent infringement claims, whether such patents are for processes or devices, that might be involved in the construction or use of the work, shall be included in the Contract amount and the Contractor shall satisfy all demands that may be made at any time for such, and shall be liable for any damages or claims for patent infringements; and the Contractor shall, at his own expense, defend any and all suits or proceedings that might be instituted at any time against the Owner for infringement or alleged infringement of any patent or patents involved in the work; and in case of an award of damages, the said Contractor shall pay such award; final payment to the Contractor by the Owner will not be made while any such suits or claims remain unsettled.

7.18 INDEMNITY

The Contractor shall indemnify and save harmless the Owner from and against all losses and all claims, demands, payments, suits, actions, recoveries, and judgments of every nature and description brought or recovered against him, by reason of any act or omission of the said Contractor, his agents or employees, in the execution of the work or in the guarding of it and this shall include acts or omission of subcontractor.

The Contractor shall, and is hereby authorized to, maintain any part for such insurance, issued in the name of the Owner, as will protect the Owner from his contingent liability under this Contract, and the Owners right to enforce against the Contractor any provision of this Section shall be contingent upon the full compliance by the Owner with the terms of applicable insurance policy or policies, a copy of which shall be deposited with the Owner.

7.19 INSURANCE

The Contractor shall secure policies of insurance in amounts, form and companies satisfactory to the Owner, and as specified in Forms A & B of the Contract.

7.20 GUARANTEES

The Contractor and any sureties under the Performance Bond guarantee to complete the project as specified and agree that loss as a result of any occurrence including acts of God, shall not relieve them of their obligation.

7.21 CONTRACTOR LIABILITY INSURANCE

The Contractor shall maintain insurance as will protect him from claims under Workmen's compensation acts and from any other claims for damages for personal injury, including death, which may arise from or by any subcontractor or anyone directly or indirectly employed by either of them.

7.22 PERFORMANCE BOND

The surety bond executed by the Contractor, issued to the Owner, shall be a guarantee:

- A. For the faithful performance and completion of the work in strict accordance with the terms of the contract, specifications, and detailed plans;
- B. For the payment to the Owner of all sums due or which may become due by the terms of the contract; as well as by reason of any violation thereof by the Contractor;
- C. For the payment of all bills, including the hire, rental or lease of equipment or machinery, and the operators thereof, used on the work, and for all materials, lubricants, oils and gasoline used in or consumed in the construction of such work and for all labor performed in such work whether by sub-contract or otherwise;
- D. The payment of any and all judgments and costs of suits and actions brought against the Owner or officials thereof, for any cause whatsoever, arising from or on account of any injuries or damages to life or property suffered or sustained by any person, firm or corporation, caused by the Contractor, his or its agents, servants or employees in the construction of said work, or by or in consequence of any negligence, carelessness or misconduct in guarding or protecting the same, or any act or omission of the said Contractor his agents, servants, employees;
- E. And for the protection of the Owner against all suits and claims for infringements or alleged infringements of patent rights processes.

This section shall in no way be construed as limiting the obligation under the Performance Bond actually furnished, but may be an addition thereto.

The Owner agrees to mail a notice to the Contractor, calling his attention to any failure to comply with the requirements of the bond, not more than ten (10) days before notifying his bondsmen of such failure to comply with the terms of said bond.

7.23 UNEMPLOYMENT COMPENSATION

The Contractor to whom the Contract is awarded, will pay the Department of Manpower Affairs of South Dakota, all contributions and interest due under the Unemployment Compensation Law of South Dakota. Further, it is required that the Contractor furnish a certificate, prior to final payment, from the Department of Manpower Affairs that all contributions and interest due to the department in performance of that Contract have been paid.

7.24 DISCRIMINATION

The Contractor will not discriminate against any employee or applicant for employment because of race, sex, creed, color or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated fairly during employment, without regard to their race, sex, creed, color, or national origin. Such action shall include, but is not limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

The Contractor will state, in all solicitations or advertisements for employees placed by or on behalf of the City, that all qualified applicants will receive consideration for employment without regard to race, sex, creed, color, or national origin.

The Contractor will send, to each labor union or representative or workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers representative of the contractor's commitments under Section 202 of Executive Order No. 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

The Contractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, of the rules, regulations, and relevant orders of the Secretary of Labor.

The Contractor will furnish all information and reports required by Executive order No. 11246 of September 24, 1965, and by the rules, regulations, and order of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

In the event of the Contractor's noncompliance with the discrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

The Contractor will include the provisions of Section 7.21 in every subcontract or purchase order unless exemption by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing such provisions including sanctions for noncompliance: provided, however, that in the event the Contractor becomes involved, in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the contracting agency, the contractor may request the United States and the City to enter into such litigation to protect the interest of the United States and the City.

7.25 LABOR AND DISMISSAL OF EMPLOYEES

The Contractor shall employ only persons who are competent and skillful in their respective lines of work, and local labor shall be given preference. Whenever the Engineer shall notify the Contractor that any person on the work is, in his opinion, incompetent, unfaithful, disorderly or under the influence of intoxicating substances, or refuses to carry out the provisions of this contract or uses threatening or abusive language to any persons, shall be immediately discharged from the work and shall not be re-employed thereon except with the consent of the Engineer.

7.26 LAWS AND ORDINANCE

The Contractor shall keep himself fully informed of all existing and current regulations of the Owner, and County, State, and National Laws which in any way limit or control the actions or operations of those engaged upon the work, or affecting the materials supplied to or by them. He shall at all times observe and comply with, all ordinances, laws, rules and regulations and shall protect and indemnify the Owner and the Owner's officers and agents against any claims or liability arising from or based on any violation of the same. 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 Drawings and Specifications are at variance therewith, he shall promptly notify the Engineer in writing and any necessary changes shall be adjusted as provided in the Contract for changes in the work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules, and regulations and without such notice to the Engineer, he shall bear all costs arising therefrom. Such performance shall constitute a waiver of any and all claims associated with the work.

7.27 PERMITS AND LICENSES

Unless otherwise specified, permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the Contractor. Permits, licenses, and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the Owner, unless otherwise specified.

7.28 DIRT/DUST CONTROL

All activities associated with this contract shall conform to Pennington County Ordinance #12, "Fugitive Dust Regulation." The Contractor shall obtain a dust control permit from the County Planning Office and furnish a copy to the Owner before beginning work on the project.

The Contractor shall make every reasonable effort to minimize fugitive dirt or dust as a result of construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions, at no additional cost to the Owner.

Upon substantial completion of construction at a given site or at any time prior to final project acceptance as directed by the Engineer, the Contractor shall clean up the project area(s) and remove all dirt and debris from the street and sidewalk surfaces to the satisfaction of the Engineer. In general, removal of the dirt and debris shall be conducted in such a way and/or at such a time as to minimize nuisance conditions of dirt and dust in the air, on vehicles, sidewalks, and buildings.

Specifically, the streets shall be swept with an approved, enclosed mechanical or vacuum-type sweeper, which picks up the dirt and debris and stores it for hauling and disposal off-site. The Contractor shall utilize a private sweeper whenever possible. However, he may request that the City Street Department do the sweeping if a private sweeper is not available when required. When the Contractor elects to utilize the City sweeper, he shall give the Engineer at least 72 hours' notice prior to the time the sweeper is desired. If the City sweeper is utilized, the City Street Department will then bill the Contractor for the use of the sweeper at the current hourly rate for sweeper and operator. If, in the opinion of the Engineer, the Contractor fails to make reasonable effort to minimize fugitive dust as a result of his construction activities, or refuses to take action when requested by the Engineer, the Engineer may elect to schedule the City sweeper

to provide cleanup. The City street Department will bill the Contractor at one and one-half times (1 1/2) the current hourly rate for the sweeper and operator.

7.29 CLAIMS AND DAMAGES

Any claim for damage arising under this contract shall be made in writing to the party liable within ten (10) calendar days of the first observance of such damage, except as expressly stipulated otherwise, and shall be adjusted by agreement or by arbitration. Failure to comply with the notice requirement will result in denial of the claim.

In general, the Contractor may not recover for claims, which did not impact the critical path of the project.

The Contractor shall document his claim(s) in the following manner:

- A. Provide an introduction and summary.
- B. Provide a listing and explanation of subsurface information available in the bidding documents and/or through a reasonable site investigation.
- C. Provide a report of the Contractor's site investigation.
- D. Explain the conditions actually encountered.
- E. Discuss the difference between actually encountered and anticipated conditions with emphasis on the impact of such things as delay, interference, disruption, changes in construction methods, and additional direct labor and equipment requirements.
- F. Summarize the applicable laws and/or contract clauses.
- G. Set forth the time extension claim with rational, detailed calculations.
- H. Set forth the cost claim broken down to the smallest elements possible.

7.30 LIENS

Neither the final payment nor any part of the retained percentage shall become due until the Contractor, if required, shall deliver to the Owner a complete release of all liens arising out of this Contract, or receipts in full in lieu thereof and, if required in either case, an affidavit that so far as he has knowledge or information the releases and receipts include all labor and materials for which a lien could be filed; but the Contractor may, if any subcontractor refuses to furnish a release or receipt in full, furnish a bond satisfactory to the Engineer, to indemnify the Owner against any lien. If any lien remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a lien, including all costs and a reasonable attorney's fee.

7.31 USE TAX LIABILITY

The Contractor shall be liable to pay the use tax on tangible personal property that is supplied by the City to the Contractor for performance of the Contractor. The value of said personal property will be as indicated in Section 2.20 of the Contract. The Contractor shall be liable to pay all Federal, State, County, or local taxes required for labor and/or materials included in this Contract.

7.32 WORK MODIFICATIONS

The Owner, without invalidating the Contract, may order extra work or make changes by altering, adding to, or deducting from the work, the Contract Sum being adjusted accordingly. All such work shall be executed under the conditions of the original Contract except that any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.

In giving instructions, the Engineer shall have authority to verbally make minor changes in the work; but otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless in pursuance of a written order by the Engineer, and no claim for an addition to the Contract Sum shall be valid unless so ordered and approved by the Council.

The value of any such extra work or change shall be determined in one or more of the following ways:

- (a) By estimate and acceptance in a lump sum.
- (b) By unit prices named in the Contract or subsequently agreed upon.
- (c) By cost and percentage or by cost and a fixed fee.

If none of these methods is agreed upon, the Contractor, provided he receives an order as above, shall proceed with the work. In such case and also under case (c), he shall keep and present in such form as the Engineer may direct, a correct account of the net cost of labor and materials, together with vouchers. In any case, the Engineer shall certify to the amount including reasonable allowance for overhead and profit, due to the contract, or pending final determination of value, payments on account of changes shall be made on the Engineer's Estimate. Work done on a Force Account basis shall be as follows:

A. Labor

For labor and supervisor in direct charge of the specific operations, the Contractor shall receive the rate of wage agreed upon in writing before beginning work or the actual rate paid in the event it is less than the agreed rate, for each and every hour that said labor and supervisor are actually engaged in such work.

If a laborer or supervisor is paid for "overtime" during a calendar week in which he is employed for part of that period on force account work, the Owner will pay to the Contractor a percentage of that portion of the overtime payment. For each such employee, this percentage will be the ratio, which the total hours he worked on force account during the week bears to the total hours he worked during that week.

Overtime incurred due to the City requiring the Contractor to do force account work, during periods not normally worked, will be paid one hundred percent (100%) by the City. In order that the Engineer may verify wages paid and pro-rate overtime, the Contractor shall furnish to the Engineer certified payrolls during the period force account work is in progress.

An amount equal to fifteen percent (15%) of the sum for labor will also be paid the Contractor as compensation for administrative and overhead costs.

B. Bond, Insurance, and Tax:

For property damage, liability, and workmen's compensation insurance premiums, unemployment insurance contributions, excise taxes, and social security taxes on the force account work, the Contractor shall receive the actual cost, to which no percentage will be added. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax. In lieu of furnishing itemized statements to substantiate these costs, of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions and Social Security tax, the Contractor may elect to receive an amount equal to twenty-five percent (25%) of the actual labor costs (excluding the fifteen percent [15%] for administrative and overhead costs) as compensation for those costs.

C. Materials

For materials accepted by the Engineer and incorporated into the project, the Contractor shall receive the actual cost of such materials delivered onto the worksite, including transportation charges paid (exclusive of machinery rentals as hereinafter set forth), to which cost fifteen percent (15%) will be added as compensation for administrative and overhead costs.

D. Equipment

For machinery or special equipment, including fuel and lubricants, plus transportation costs, the use of which has been directed or authorized by the Engineer, the

Contractor shall be paid at an agreed upon rate; or, failing mutual agreement, in accordance with provisions and rates set forth in the current edition of the South Dakota Department of Transportation Equipment Rental Rates, for actual time such equipment is in operation on the work, except that standby costs will not be paid. Nor will additional amounts be added for administration and overhead cost.

E. Miscellaneous

Additional allowance will not be made for general superintendence, cost of maintaining home office, standby costs, or other costs for which no specific allowance is herein provided.

F. Compensation

The Contractor's representative and the Engineer shall compare records of the cost of work done as ordered on a force account basis.

G. Statements

Payment will be made for work performed by force account based on itemized statements of the cost of such force account work detailed as follows:

1. Certified payrolls showing worker name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman;
2. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment;
3. Quantities of materials, prices and extensions;
4. Transportation of materials; and
5. Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.

Statements shall be accompanied and supported by receipted invoices for materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then, in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from his stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

H. To the sum of items A through C, shall be added ten percent (10%) for profit.

7.33 EXTRA WORK A PART OF CONTRACT

If extra work orders are in accordance with the provisions of this Contract, such work shall be considered a part hereof and subject to each and all of its terms and requirements.

7.34 UNKNOWN OR CONCEALED CONDITIONS

Whenever, during excavating operations, the Contractor encounters a heretofore unknown underground utility or other unknown or unexpected physical condition, the existence of which could not have reasonably been foreseen or anticipated and which causes a significant delay and/or expense to the Contractor, he shall contact the Engineer, before such conditions are disturbed, for a determination as to whether compensation will be allowed.

Compensation may consist of a payment to the Contractor and/or an extension of contract time. However, no compensation will be allowed unless notice is given prior to disturbing the condition. Should the Engineer allow payment, he will pay for reasonable and justifiable costs involved in dealing with the condition as specified in Section 7.29 of these specifications.

Extra contract time shall be based on the actual time of the delay caused by encountering the condition.

7.35 SUSPENSION AND ANNULMENT OF CONTRACT

If the equipment, material, or work to be furnished under this contract shall be abandoned by the Contractor, or if this Contract shall be assigned or the work sublet by him, or if at any time the Engineer shall be of the opinion, and shall so certify in writing to the Owner, the performance of this Contract is unnecessarily delayed, or that the Contractor is willfully violating any of the conditions or covenants of this Contract or of the specifications, or is executing the same in bad faith or not in accordance with the terms of said Contract, or if the work be not fully completed within the time named in this Contract for its completion, or within the time to which the completion of this Contract may be extended, the Owner may notify the Contractor to discontinue all work, or any part thereof, then the Owner is hereby empowered to suspend or annul this Contract.

If this Contract be so annulled or suspended, the Contractor shall not be entitled to anything on account thereby, nor shall such annulment or suspension in any way affect the right of the owner to damages claimed by it on account of the failure of the Contractor, but such annulment must be ratified by the Owner before being of any force or effect. In the case of annulment of this Contract before completion from any cause whatever, the Contractor, if notified to do so by the Owner, shall promptly remove any part or all of this equipment and supplies from the property of the Owner, failing which,

the Owner shall have the right to remove such equipment and supplies at the expense of the Contractor.

7.36 CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

If the work should be stopped under an order of any court, or other public authority, for a period of three months, through no act or fault of the Contractor or of anyone employed by him, then the Contractor may, upon seven (7) days' notice in writing to the Owner and the Engineer, stop work or terminate this Contract and recover from the Owner payment for all work executed and partially executed and reasonable profit.

7.37 ENGINEER'S RIGHT TO STOP WORK

Should traffic, weather, or conditions caused by the actions or inactions of the Contractor dictate, the Engineer may issue a Stop Work Order to the Contractor. Upon receiving a Stop Work Order, the Contractor shall stop working and shall backfill and compact all open holes and/or trenches, properly sign, identify, and clean up the project to the satisfaction of the Engineer. When conditions improve, the Engineer will issue a Notice to Proceed for the remainder of the project. The Contractor will then have a ten (10) day equipment-ready period before contract time resumes. Remaining work shall be completed within the contract time.

7.38 ARBITRATION

A. Demand for Arbitration

Any decision of the Engineer, which is subject to arbitration shall be submitted to arbitration upon the demand of either party of the dispute.

The Contractor shall not cause a delay of the work because of the pendency of arbitration proceedings, except with the written permission of the Engineer, and then only until the arbitrators shall have an opportunity to determine whether or not the work shall continue until they decide the matters in dispute.

The demand for arbitration shall be delivered in writing to the Engineer and the adverse party, either personally or by registered mail to the last known address of each, within ten (10) days of the receipt of the Engineer's decision, and in no case after final payment has been accepted except as otherwise expressly stipulated in the Contract Documents. If the Engineer fails to make a decision within a reasonable time, a demand for arbitration may be made as if his decision had been rendered against the demanding party.

B. Arbitrators

No one shall be nominated or act as an arbitrator who is in any way financially interested in this Contract or in the business affairs of the Owner, or the Contractor, or the Engineer, or otherwise connected with any of them. Each arbitrator shall be a person in general familiar with the work or the problem involved in the dispute submitted to arbitration.

Unless otherwise provided by controlling statutes, the parties may agree upon one arbitrator; otherwise there shall be three, one named in writing by each party to this Contract, to the other party, and the third chosen by those two arbitrators, or if they should fail to select a third within fifteen days, then he shall be appointed by the presiding officer, if a disinterested party, of the Bar Association nearest the location of the work. Should the party demanding arbitration fail to name an arbitrator within said ten days, then said presiding officer shall appoint such arbitrator within ten days, and upon his failure to do so then such arbitrator shall be appointed on the petition of the party demanding arbitration by a judge of the Federal court in the district where such arbitration is to be held.

The said presiding officer shall have the power to declare the positions of any arbitrator vacant by reason of refusal or inability to act; sickness, death, resignation, absence or neglect. Any vacancy shall be filled by the party making the original appointment, and unless so filled within five days after the same has been declared, it shall be filled by the said presiding officer. If testimony has been taken before a vacancy has been filled, the matter must be reheard unless a rehearing is waived in the submission or by the written consent of the parties.

If there be one arbitrator, his decision shall be binding. If three, the decision of any two shall be binding in respect to both the matters submitted to and the procedure followed during the arbitration. Such decision shall be a condition precedent to any right of legal action.

C. Arbitration Procedure

The arbitrators shall deliver a written notice to each of the parties and to the Engineer, either personally or by registered mail to the last known address of each of the time and place for the beginning of the hearing of the matters submitted to them. Each party may submit to the arbitrators such evidence and argument as he may desire and the arbitrators may consider pertinent. The arbitrators shall, however, be the judges of all matters of law and fact relating to both the subject matters of and the procedure during arbitration and shall not be bound by technical rules of law or procedure. They may hear evidence in whatever form they desire. The parties may be represented before them by such person as each may select, subject to the disciplinary power of the arbitrators if such representative shall interfere with the orderly or speedy conduct of the proceeding.

Each party and the Engineer shall supply the arbitrators with such papers and information as they may demand, or with any witness whose movements are subject

to their respective control, and upon refusal or neglect to comply with such demands the arbitrators may render their decision without the evidence which might have been elicited therefrom and the absence of such evidence shall afford no grounds for challenge of the award of the party refusing or neglecting to comply with such demand.

The submission to arbitration (the statement of the matters in dispute between the parties to be passed upon by the arbitrators) shall be in writing duly acknowledged before a notary. Unless waived in writing by both parties to the arbitration, the arbitrators, before hearing testimony, shall be sworn by an officer authorized by law to administer an oath, faithfully and fairly to hear and examine the matters in controversy and to make a just award according to the best of their understanding.

The arbitrators, if they deem the case demands it, are authorized to award to the party whose contention is sustained such sums as they shall assess the costs and charges of the arbitration upon either or both parties.

The award of the Arbitrators shall be in writing and acknowledged like a deed to be recorded, and a duplicate shall be delivered personally or by registered mail, forthwith upon its rendition, to each of the parties to the controversy and to the Engineer. Judgment may be rendered upon the award by the Federal Court or the highest State Court having jurisdiction to render same.

The award of the arbitrators shall not be opened to objection on account of the form of the proceedings or the award, unless otherwise provided by the controlling statutes. In the event of such statutes providing otherwise than as previously specified herein, the method of procedure throughout and the legal effect of the award shall be wholly in accord with said statutes, it being the intention hereby to lay down a principle of action to be followed, leaving its local application to be adapted to the legal requirements of the jurisdiction having authority over the arbitration.

The Engineer shall not be deemed a party to the dispute. He is given the right to appear before the arbitrators to explain the basis of his decision and give such evidence as they may require.

7.39 SUGGESTIONS TO CONTRACTOR ADOPTED AT HIS OWN RISK

Any plan or method of work suggested by the Engineer to the Contractor, not specified or required in the contract, adopted or followed by the Contractor in whole or in part, shall be used at the risk and responsibility of the Contractor; and the Engineer and the Owner shall assume no responsibility therefore.

7.40 SUBLETTING OF CONTRACT

The Contractor shall perform, with his own organization, work amounting to not less than fifty (50) percent of the original total contract price, except that any items designated by

the City as "Specialty Items" so performed may be deducted from the original contract price before computing the amount of work required to be performed by the Contractor with his own organization.

Any items that have been selected as "Specialty Items" for the contract are listed as such in the proposal.

No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the Engineer. The Contractor shall request permission, in writing, to sublet, assign or otherwise dispose of any portion of the contract and shall list the names and addresses of proposed subcontractors. The Contractor shall provide a statement that the organization(s) which will perform the work is (are) particularly experienced and equipped for such work and shall provide proof that the proposed subcontractor(s) is (are) licensed to perform the work in South Dakota. The Contractor shall give assurance that all pertinent provisions of the prime contract, including the minimum wage for labor as stated in his proposal, shall apply to all work sublet, assigned or otherwise disposed of in any way. Such assurance shall be accomplished in the manner required by the Engineer. Consent to sublet, assign or otherwise dispose of any portion of the contract shall not be construed to relieve the Contractor of any responsibility for the fulfillment of the Contract.

It will not be permissible for a Subcontractor to sublet work, but any work sublet to a Subcontractor can be canceled or reassigned upon request from the prime Contractor and approval of the Engineer.

The Contractor shall accept full responsibility for actions or omissions of his subcontractors and their employees as he would if they were his own. See paragraph 7.12 of these Specifications.

If evidence and investigation establish beyond reasonable doubt that a violation of the fifty percent (50%) subcontract rule is being or has been attempted through subterfuge whereby one Contractor's equipment is directly or indirectly leased to another Contractor, or whereby a significant part of one Contractor's regular working force is placed on the payroll of another Contractor, such a conclusion shall constitute a violation of the subcontract rule. This provision shall not be construed to include in the fifty percent (50%) limitation the lease of or use of equipment of a corporation or company wholly owned by the Prime Contractor.

In the case of violation of the subcontract rule, the Rapid City Council may suspend the bidding qualifications of such Contractors for a period of up to one year.

The value of work proposed for subcontract will be determined by multiplying that portion of the original contract item quantities to be sublet by the corresponding unit price as set forth in the contract.

If any phase of work involved on a contract item is sublet, the entire contract unit cost of the item will be used for determining the value of work. Materials provided by the

Contractor for a subcontractor on a particular work item will not qualify that item as work done by the Contractor.

Work performed with equipment not owned by the Prime Contractor will be considered subcontract work unless the origin of such equipment meets one of the following conditions:

1. Equipment supplied by an established equipment dealer on a rental or rental purchase agreement.
2. An occasional piece of equipment temporarily obtained from another Contractor or from an individual or company engaged in similar work.
3. Special equipment, not normally owned for the type of work involved.
4. Trucks used to haul gravel or other materials to the project.

Equipment used by a Subcontractor, must be owned by the Subcontractor or Prime Contractor, except that equipment listed above.

Should any subcontractor fail to perform in a satisfactory manner the work undertaken by him, such subcontract shall be immediately terminated by the Contractor upon written notice from the Owner.

Nothing contained in the contract documents will create a contractual relation between the City and any subcontractor.

7.41 PUBLIC SAFETY AND WORK PROTECTION

Whenever, in the opinion of the Engineer, the Contractor has not taken sufficient precaution for the safety of public or the protection of the work to be constructed under this contract, or of adjacent structures or property which may be injured by process of construction on account of such neglect, and whenever, in the opinion of the Engineer, an emergency shall arise and immediate action shall be considered necessary in order to protect the public or private personal property interest, then, the Engineer, with or without notice to the Contractor, may provide suitable protection to the said interests by causing such work to be done and material to be furnished and placed as the Engineer may consider necessary and adequate. The cost and expense of such work and material so furnished shall be borne by the Contractor, and if the same shall not be paid on presentation of the bills therefore, then such costs shall be deducted from any amounts due or to become due the Contractor. The performance of such emergency work under the direction of the Engineer shall in no way relieve the Contractor of responsibility for damages which may occur during or after such precaution has been duly taken by the Engineer.

7.42 BARRICADES AND WARNING SIGNS

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road.

It shall be the Contractor's responsibility to clear the work area of private vehicles as necessary.

All barricades, warning signs, lights, temporary signals, and other protective devices must conform with the current Manual of Uniform Traffic Control Devices.

7.43 USE OF EXPLOSIVES

When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damage resulting from the use of explosives and shall meet all local, State, and Federal laws and requirements pertaining to explosives as well as Title 29 and Title 30, Code of Federal Regulations, Part 1926, Occupational Safety and Health Act regulations for construction (OSHA), whichever is most restrictive, in the use, loading, transportation, and storage of explosives and blasting agents.

The Contractor shall obtain a blasting permit from the Rapid City Fire Department prior to the use of any explosives. The Fire Department may impose restrictions on the quantities, methods, and materials utilized for blasting.

The Contractor shall notify property owners and public and private utility companies having structures or facilities in proximity to the site of the work of their intention to use explosive. Such notice shall be given sufficiently in advance to enable them to protect their property from injury. In no case shall notice be given less than five (5) calendar days prior to the desired date of usage.

The Engineer may require the Contractor to monitor certain properties during actual blasting in order to determine effects of blasting. In some cases, the Engineer may require the use of a seismograph to document the forces of blasting.

It is recommended that, prior to blasting, the Contractor document the condition of structures in the vicinity of the work.

7.44 PROTECTION OF UTILITIES AND PROPERTY

The type, size, location, and number of all known underground utilities are approximate when shown on the plans. The Contractor shall be responsible for determining and verifying the existence, depth, and location of all underground utilities within the work limits.

The Contractor shall give reasonable notice to the owner or owners of steam, gas, water, sewer, and other pipe lines, or conduits, overhead and underground wire or other structures, either public or private, railroads and other owners of property, when such property is liable to injury or damage of the execution of the work, in order that the owner or owners of such utility or other property may locate, relocate, remove or protect the same.

If the Owner or owners of any private or public property liable to be affected, endangered, or damaged by the construction of this work, does not protect its or their property, then the Contractor shall do so.

The Contractor shall use every precaution on the work to prevent harm or accident to the property, passengers, employees, or patrons of utilities, either publicly or privately owned, and to any other person legitimately employed on the premises, and the Contractor shall assume all liability for damages accruing from any accident, which may be due to his carelessness, omission or neglect; he shall pursue the work under and along and near such property as may be liable to damage thereby, as rapidly as possible when once the work is begun.

The Contractor shall satisfactorily shore, support and protect any and all pipe and other structures or utilities and shall not be entitled to any damage or extra pay on account of any postponement, interference, or delay caused by any such structures being on the line of the work, whether such structures are shown on the plans or not. Contractor shall save Owner harmless from any and all liability or expense for injuries, damages, or repair to any public or private property.

7.45 CONDEMNED MATERIALS AND STRUCTURES

The Contractor, at his own expense, shall remove from the site of the work, without delay, all rejected and condemned materials or structures of any kind whether or not incorporated into the work and shall promptly remove and re-execute all condemned work and will bear the expense of making good any work destroyed or damaged by removal of defective work, and upon his failure to do so or to make satisfactory progress in so doing, within forty-eight (48) hours after the service of a written notice for the Engineer ordering such removal, the condemned materials, work, or structure may be removed by the Owner and the cost of such removal be taken out of the money that may be due or may become due the Contractor on account of or by virtue of this contract. No

such rejected or condemned material shall again be offered for use by the Contractor under this or other contract under this project.

7.46 MAIL BOXES

When necessary, mail boxes shall be removed and reset in a manner prescribed by the Postmaster of the Federal Post Office, Rapid City, South Dakota. A copy of the postal regulations can be obtained from the Postmaster.

It is expected that the Contractor shall give his full cooperation to the postal department concerning mail delivery during the construction of this project.

The owner of any structurally unsound mail box post shall furnish a new post at his expense. However, the Contractor shall not remove such a post until he has notified the project inspector.

Costs associated with this item shall be incidental to the project.

7.47 PROVIDING ACCESS

The Contractor shall conduct construction activities in such a manner as to provide continuous access to all affected properties during the duration of the project, unless the specific activity precludes continuous access. At no time shall the Contractor park equipment in front of or in any other way block a driveway or other entrance such that there is no means of ingress and/or egress to or from a property. Should such a situation occur, the Contractor shall take the necessary steps to provide immediate and safe access to or from the property.

Failure to provide access in a timely manner will cause the Owner to take the necessary action and bill the Contractor one and one-half (1 and 1/2) times the cost incurred.

7.48 SATURDAY, SUNDAY, HOLIDAY, AND NIGHT WORK

No work shall be done on Sundays and legal holidays, except such work as is necessary for the proper care and protection of work already performed, and, in any case only with the written permission of the Engineer; or, in case of emergency, which also requires the immediate notification of the Engineer. The Contractor shall request, and must receive, in writing, permission from the Engineer to enable work on Sundays and legal Holidays, except such work as noted above.

No work shall be done on Saturdays, except for emergencies, without the permission of the Engineer. The Contractor shall request permission from the Engineer to work on a given Saturday a minimum of 24 hours in advance, except such work as noted above.

No work, except for emergencies, shall be done between the hours of 9 P.M. and 6 A.M. unless the Contractor first obtains the written permission of the Engineer; such permission may be revoked at any time by the Engineer if the Contractor fails to maintain, at night, adequate force and equipment for reasonable prosecution and supervision of the work, or if Contractor's operations are unnecessarily disruptive to the public.

7.49 WORK DONE WITHOUT LINES, GRADES, OR INSPECTION

Any work done without lines or grades or without the inspection of an Inspector or other representative of the Engineer may be ordered removed and replaced at the Contractor's cost and expense. In-place testing or other verification data can be requested by the Engineer at the Contractor's expense. Disregard of this requirement shall result in a Stop Work Order being issued until the Contractor provides the Engineer with an acceptable plan of prior notification procedures.

7.50 STAKING WORK

The Engineer shall furnish all necessary labor and materials to set the necessary stakes for grade and alignment for all work, but it will be the Contractor's responsibility to preserve such stakes after they are once set by the Engineer. Stakes removed, damaged, etc. by Contractor negligence shall be replaced at Contractor expense. The Engineer may require the Contractor to replace the stakes or may elect to replace the stakes and charge the Contractor for the associated costs.

All work done under this Contract shall be done to the lines and grades shown on the plans or as staked by the Engineer. The Contractor shall keep the Engineer informed, a reasonable time in advance, nominally a period of one (1) full working day, of the times and places at which he wishes to do work, in order that lines and grades may be furnished, and necessary measurements for record and payment may be made with the minimum of inconvenience to the Engineer and of delay to the Contractor. The Contractor shall determine the meaning and intent of all stakes, measurements, and marks prior to commencing work. Contractor shall be responsible for protecting stakes from displacement.

7.51 MATERIALS

A. General

The Contractor shall furnish only new and best commercial quality material, equipment, appliances, and supplies for the work. Bid prices shall include all sales and other taxes payable on all items incorporated in the permanent work.

Anything specified by manufacturer's name or proprietary name shall be furnished exactly as called for unless followed by the words "or approved equivalent". The decision of equity, will be made by the Engineer.

B. Samples

When requested by the Engineer, samples or test specimens of materials to be used or offered for use in connection with this work shall be prepared at the expense of the Contractor and furnished by him in such quantities and sizes as may be required for proper examination and test, with all carriage charges prepaid and with information as to their sources. All samples shall be submitted in ample time to permit the making of proper tests, analyses, or examination before the time at which it is desired to incorporate the material into the work. The cost of making all tests, and the cost of materials used in such tests, shall be paid by the Contractor, unless otherwise specified. Tests other than those which can be made in the field by the Engineer or can be arranged to be made by him elsewhere, shall be made by a properly equipped laboratory of established reputation. Reports of all tests shall be mailed to the Owner, to the Engineer, and to the Contractor.

C. Warranty

The Contractor warrants to the Owner that all materials and equipment furnished and installed under this contract will be new unless otherwise specified, and shall be of good quality, free from defects, and in conformance with the plans and specifications. All materials not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

7.52 CLEANUP AND RESTORATION

The Contractor shall not allow the site of the work to become littered with trash and waste material, but shall maintain the same in a neat and orderly condition throughout the construction period. The Engineer shall have the right to determine what is or is not waste material or rubbish and the manner and place of disposal.

The Owner reserves the right to require the Contractor to clean up all or any portion(s) of the project at any time prior to final project acceptance.

On or before the end of contract time, the Contractor shall, at his own expense, dismantle and/or remove all temporary structures built or furnished by him and shall replace or repair all areas disturbed as a result of this project to original condition or better.

If all other work has been completed, and winter weather, availability of materials such as hot mix asphalt or sod, or other conditions prevent complete cleanup and restoration, the Contractor shall clean up the project area(s) to the satisfaction of the Engineer prior

to suspending work. After cleanup has been approved, the Engineer will issue a Stop Work Order, and contract time will stop. When conditions are once again suitable and/or materials are available, the Engineer will issue a Notice to Proceed, giving the Contractor ten (10) calendar days to resume cleanup and restoration.

All cleanup and restoration shall be completed within the remaining Contract time. If additional contract time is necessary, the Contractor shall request a time extension as set forth in these General Conditions.

If complete cleanup and restoration is not possible, for whatever reason, the Contractor will be responsible for satisfactorily maintaining all disturbed areas until such time as they are restored. Should any maintenance work be required on any portion of the project prior to issuance of the acceptance letter, the Contractor shall do so within forty-eight (48) hours of receiving notice from the Engineer. Failure to do so will cause the Owner to do the necessary work and bill the Contractor one and one-half (1 1/2) times the cost incurred.

7.53 TESTING OF COMPLETED WORK

Before final acceptance, all parts of the work shall be tested and each part shall be in good condition and proper working order or shall be placed in such condition and order at the expense of the Contractor, unless otherwise specified. All tests of completed work required under this contract shall be made under the direction of the Engineer by and at the expense of the Contractor, who shall repair at his own expense all damage resulting therefrom.

7.54 PLACING WORK IN SERVICE

If desired by the Owner, portions of the work, as substantially completed, may be placed in service, the Contractor to give proper access to the work for this purpose; but such use and operation shall not constitute an acceptance of the work, and the Contractor shall warrant the work as specified in Section 7.51. If such prior use increases the cost of or delays the work, the Contractor shall be entitled to such extra compensation, or extension of time, or both, as the Owner may determine.

7.55 COMPLETION AND ACCEPTANCE OF WORK

The Engineer, upon completion of the contract work, shall satisfy himself by examination and test that the work has been finally and fully completed in accordance with the Specifications and Contract, and report such completion to the Owner.

7.56 ESTIMATED QUANTITIES

The Contractor agrees that the quantities of work as stated in the Bid Proposal or indicated on the plans are only approximate, and that during the progress of the work the Owner may find it advisable, and shall have the right to omit portions of the work and to increase or decrease the quantities, and that the Owner reserves the right to add or to take from any items as may be deemed necessary or desirable. Under no circumstances or conditions will the Contractor be paid anything on account of anticipated profits upon the work or any portion thereof covered by this contract, which is not actually performed and which has not actually entered into the construction of said improvement.

7.57 METHOD OF MEASUREMENT

Unless specifically stated otherwise in this Contract, no extra measurement or measurements according to local custom of any kind shall be allowed in measuring the work under this Contract, but only the length, area, solid contents, number, weight, or time in standard units, as the case may be, shall be considered. The Contractor will be required at his expense to furnish all scales and equipment to properly weigh and measure the various units.

7.58 PAYMENT**A. General**

In consideration of the faithful performance by the Contractor and of all the conditions, provisions, and covenants of this Contract and the Specifications to the satisfaction of the Owner, the Owner shall pay and the Contractor shall receive the prices stipulated in his Bid Proposal attached hereto and made a part hereof, as full compensation for everything furnished or done by the Contractor under this Contract. The Owner also agrees to pay in addition such amounts as may be agreed upon for alteration in accordance with Section 7.32 and for extra work in accordance with Section 7.33.

Unless otherwise specified, lump sum bid items will be paid for in one lump sum following 100 percent (100%) completion and acceptance of the item by the Engineer.

B. Mobilization

When there is a bid item for "Mobilization" in the Bid Proposal, payment for this item will be made for preparatory work and operations performed by the Contractor, including, but not limited to those necessary for the movement of his personnel, equipment, supplies, and incidentals to the project site; for the establishment of all

offices, buildings, and other facilities necessary for work on the project; and for other work operations that must be performed, or for cost incurred before beginning work on the various items on the project site.

Cost of premiums on bonds and insurance for the contract are not to be included in mobilization. No separate measurement will be made for this item. Partial payment, when allowed, shall be made according to the following schedule:

1. Twenty-five percent (25%) of the amount bid for mobilization shall be paid when five percent (5%) of the original contract amount is paid.
2. An additional twenty-five percent (25%) of the amount bid for mobilization will be paid when ten percent (10%) of the original contract amount is paid.
3. An additional ten percent (10%) of the amount bid for mobilization will be paid when twenty-five percent (25%) of the original contract amount is paid.
4. The remaining forty percent (40%) of the amount bid for mobilization will be paid when fifty percent (50%) of the original contract amount is paid.

When no bid item for "Mobilization" is included in the Bid Proposal, such costs shall be considered incidental to the various work items. In such case, no additional payment will be made for mobilization.

7.59 PROJECT PAYMENT

A. Partial Payment Project

For a project specified as a Partial Payment Project in Section 2, INFORMATION AND INSTRUCTIONS TO BIDDERS, payments will be made once each month as the work progresses or as requested by the Contractor, whichever is longer. Said payments will be based upon estimates prepared by the Engineer of the value of the work performed and materials complete, in place, and for materials delivered, in accordance with the Contract.

No partial payment will be made when the total value of the work done since the last estimate amounts to less than \$2,500.00.

From the total of the amounts ascertained as payable, an amount equivalent to 12% of the amount on the Contract up to \$50,000.00; 5% of the next \$200,000.00; and 2 1/2% of the amount of the Contract in excess of \$250,000.00 will be deducted and retained by the City until after completion of the entire Contract in an acceptable manner. The balance, less all previous payment, shall be certified for payment.

When the work under Contract has been completed and accepted, and it is anticipated that preparation of the final estimate will not be completed within ninety (90) days of when the work has been substantially completed to the extent that only

minor or incidental operations remain to fully complete all of the work under the Contract. If the completion of such work is deferred or delayed in compliance with Contract provisions or, upon order of the Engineer, suspending operations by virtue of weather or climactic conditions or because of seasonal restrictions provided for in the Contract, upon written request of the Contractor and consent of the surety provider, the Engineer may prepare an estimate as figured from Contract unit prices.

Payment, either in full or partial, for materials delivered to or stockpiled on the project and not yet incorporated in the work in their final position shall be as specified in Section 2, INFORMATION AND INSTRUCTION TO BIDDERS.

Partial progress payments will be made upon written request by the Contractor on specific items, as listed herein, which are stockpiled in a manner and location satisfactory to the Engineer.

B. Single Payment - Assessed Projects

For a project specified as a Single Payment - Assessed Project in Section 2, INFORMATION AND INSTRUCTIONS TO BIDDERS, there will be no partial payments under the Contract, but only one final payment when the work is fully completed; accepted by the Owner; final estimate determined; assessment roll issued and approved; and the assessment bonds issued by the Owner to cover the entire cost of the project.

As soon as the work has reached a point where the Engineer can finally determine the exact cost of the construction, the Engineer will make out his final estimate and assessment roll and determine the full costs of the work and submit them for approval. After the final approval of the final estimate and assessment roll, the Owner shall, as quickly as practical, sell the special assessment bond for the work.

After the above-outlined procedures have been completed, and upon full completion of the work by the Contractor and acceptance of the work by the Engineer as filed with the Owner, the Owner shall pay to the Contractor, in cash, the full amount of his final estimate.

C. Single Payment - Non-Assessed Projects

For a project specified as a Single Payment - Non-Assessed Project in Section 2, INFORMATION AND INSTRUCTIONS TO BIDDERS, one (1) lump sum final payment will be made after completion of the work, acceptance by the Engineer, and formal acceptance by the Owner.

7.60 DEDUCTION FOR UNCORRECTED WORK

If the Engineer determines it inexpedient to correct damaged or nonconforming work, an equitable deduction from the contract price can be made upon certification of the amount by the Engineer.

7.61 PAYMENTS WITHHELD

The Owner may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any pay certificate to such extent as may be necessary to protect himself from loss on account of:

- A. Defective work not remedied.
- B. Claims or liens filed or reasonable evidence indicating probable filing of claims or liens.
- C. Failure of the Contractor to make payments properly to subcontractors or for material, labor, or equipment.
- D. A reasonable doubt that the Contract can be completed for the balance then unpaid.
- E. Damage to another Contractor, work, or property.
- F. Reasonable doubt that Contractor can complete the work within the stipulated contracted time.
- G. The cost to the Owner resulting from failure to complete the work on time.
- H. Failure to provide revised project schedules when requested by the Engineer.
- I. Failure to provide acceptable construction and labor rate schedules.
- J. Failure to provide a job superintendent who is in responsible charge of all work of the project and is on the job site when work is being performed.

When the above grounds are removed, payment shall be made for amounts withheld because of them.

7.62 VALUE ENGINEERING INCENTIVE

A. General

Value Engineering Incentive applies to those cost reduction proposals initiated and developed by the Contractor for changing the drawings, designs, specifications, or other requirements of the contract. It does not apply to such proposal unless it is identified by the Contractor at the time of submission to the Owner as a Value Engineering Incentive proposal.

The cost reduction proposals contemplated are those that:

1. Would require a change order to this contract.

2. Would result in savings to the City by providing less costly items or methods than those specified in the contract without impairing any of their essential functions and characteristics such as service life, reliability, economy of operation, ease of maintenance, and necessary standardized features.
- B. Cost reduction proposals shall be processed in the same manner as prescribed for any proposal, which would require a change order. As a minimum, the following information shall be, submitted by the Contractor with each proposal:
1. A statement that this proposal is submitted as a Value Engineering Incentive.
 2. A description of the proposal.
 3. An itemization of the requirements of the contract, which would require a change and a recommendation of how to make each change.
 4. An estimate of the reduction in performance costs that will result from adoption of the proposal.
 5. A prediction of any effects the proposed change would have on other costs to the City.
 6. A statement of the time the change order must be issued to obtain the maximum cost reduction during the remainder of the contract and the reason for this time schedule.
 7. The dates of any previous submission of the proposals, including contract numbers and the actions of the City.
 8. A statement as to the effect the proposal would have on the time for completion of the project.
- C. The City shall not be liable for delay in acting upon a proposal submitted. The decision of the Engineer as to the acceptance of any such proposal shall be final and shall not be subject to Section (5.17). The Engineer may accept, in whole or in part, cost reduction proposals submitted by issuing a change order.

If a cost reduction proposal is accepted, an equitable price adjustment in the contract price and in other affected provisions of this contract shall be made in accordance with this Specification or other applicable provisions in this contract. The equitable adjustment shall be established by determining the effect of the proposal on the Contractor's cost of performance. When the cost of performance of this contract is decreased as a result of the change, the contract price shall be reduced by the following amount: The total estimated decrease in the Contractor's cost of performance less fifty percent (50%) of the difference between the amount of such total estimated decrease and net increase to the City which must reasonably be incurred as a result of application of the cost reduction proposal to this contract. If

the change order results in an increase in the cost of performing the contract, this Specification shall not apply, and the increase shall be determined in accordance with Section 4.

- D. The substitution of one bid item for another bid item resulting in a decrease in the contract amount will not be considered as a saving under Value Engineering Incentive. When change involves the increase of one bid item and the decrease of another bid item, the change order will be made in conformance with the applicable clauses of Section 7.
- E. The Contractor may restrict the City's right to use or disclose the information submitted with a Value Engineering proposal for other purposes. Such restrictions must be in writing and be submitted with the proposal.
- F. If the proposal is accepted, this restriction shall be void, and the City may use, duplicate, or disclose, in whole or in part, data necessary to utilize such proposal.

7.63 DETERMINATION AND EXTENSION OF CONTRACT TIME

The "Contract Time," or number of days allowed for the performance and completion of the work included in the contract, will be stated in the proposal and contract.

When the contract time is on a working day basis, the contract time will begin on the date determined in the Notice to Proceed and continue at the rate of one contract day charged for each day of the normal working week, Monday through Friday, except as described herein, until the work is complete. Holidays, Saturdays, and Sundays will not be included in the count of working days, except those days the Contractor has requested and been granted permission to work. No working day shall be charged when conditions beyond the control of the Contractor preclude prosecution of the work. Working days will be charged if the Contractor permits construction operations to proceed for five (5) or more hours of the day during the normal working week, or if the Contractor has requested, and been granted, permission to work on Holidays, Saturdays, or Sundays, and if, in the opinion of the Engineer, conditions allow progress of work on items essential to the completion of the project for a period of five (5) or more hours of the day.

When the contract is on a calendar day basis, contract time shall be the time from the date determined in the Notice To Proceed to the date on which all work on the project shall be completed. Holidays, Saturdays and Sundays will be included in the count of calendar days. No calendar day shall be charged when conditions beyond the control of the contractor preclude prosecution of the work. Calendar days will be charged if the Contractor permits construction operations to proceed for five (5) or more hours of the day or if, in the opinion of the Engineer, conditions allow progress of work on items essential to the completion of the project for a period of five (5) or more hours of the day.

The Engineer will, upon written request, furnish the Contractor a statement showing the number of days charged to the contract. The Contractor will be allowed seven (7)

calendar days from receipt in which to file a written protest setting forth in what respect said statement is incorrect; otherwise, the statement shall be deemed to have been accepted by the Contractor as correct. If the Engineer and the Contractor fail to reach an agreement on any statement of working days, the Engineer shall refer the statement in question to the Director of Public Works for his review and final decision.

When the contract completion time is a fixed calendar date, it shall be the date on which all work on the project shall be substantially completed. If work is not completed by the date specified, the Engineer will keep a record of working days charged after that date and will charge the Contractor on a working day basis.

Holidays, Saturdays, and Sundays will be excluded from the count of working days unless the Contractor has been granted permission to and/or utilizes such a day for construction work for five (5) or more hours of the day or if, in the opinion of the Engineer, conditions allow progress of work on items essential to the completion of the project for a period of five (5) or more hours of the day. The Contractor shall not carry on construction operations on Sundays or holidays without written permission from the Engineer, except for purposes of making emergency repairs and providing proper protection of the work, such as curing of concrete.

Days on which the work has been suspended by an action, non-action, or an omission made by the City, but through no fault of the Contractor, and days not worked because of strikes, lockouts, unusual delays in transportation, or any condition over which the Contractor has no control, shall not be counted against the contract time.

The number of days for performance allowed in the contract as awarded is based on the original quantities as outlined in the Bidder's Proposal. If satisfactory fulfillment of the contract requires performance of extra work or work on items with an increase in quantities that will take additional time to complete, the number of days allowed for performance shall be increased in the same proportion as the cost of increased work bears to the total original contract amount. Should the Contractor feel that the extension based on a monetary basis is insufficient for the increased work involved, he may submit written information, which will justify additional time. Such information must show how the increased work delays the overall completion of the entire project. Information shall be submitted as soon as possible after the increased work has been performed. If, in the opinion of the Engineer, the information submitted justifies additional time, a Construction Change Order increasing the contract time will be prepared.

When the Contractor wishes to suspend contract time due to weather, he shall make a written request to the Engineer within ten (10) working days of the first weather day for which he desires a time suspension. Failure to comply with this notice requirement could result in denial of that request.

If the Contractor finds it impossible, for reasons beyond his control, fault, or negligence, to complete the work within the contract time as specified or as extended in accordance with the provisions of this subsection, he may, at any time, request to the Engineer for an extension of time, setting forth therein the reasons which he believes will justify the granting of his request. Such request shall be submitted within ten (10) days of the start

of each occurrence for which an extension is desired. Failure to comply with notice requirements shall constitute a waiver, and failure to file a claim for additional compensation due to the delay at the time the Contractor requests the time extension bars him from claiming additional compensation for it.

The Contractor's plea that insufficient time was specified is not a valid reason for extension of time.

If the Engineer finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. Extension of contract time will be made when unanticipated delays (beyond the control of the Contractor) in delivery of critical materials results in a delay of the work. The Contractor shall notify the Engineer immediately when it becomes evident that there will be a delay in obtaining critical materials. The extended time for completion shall then be in force and effect the same as though it were the original time for completion.

When final acceptance has been duly made as prescribed in Section 7.55, the daily time charge will cease.

7.64 LIQUIDATED DAMAGES

For each working day, as specified, that any work shall remain uncompleted after the contract time specified for the completion of the work provided for in the contract, the sum specified in the following schedule will be deducted from any money due the Contractor not as a penalty but as liquidated damages; provided, however, that due amount will be taken off any adjustment of the contract time. Liquidated damages shall be understood to be compensation to the Owner for costs incurred directly by the Owner or indirectly by the users of the facility for the delay in completion of the work. These costs include, but are not limited to, increased travel times; loss of access to homes or businesses; inconvenience from loss of sewer or water uses; fire protection, etc., beyond those circumstances anticipated for timely completion of the work.

SCHEDULE OF LIQUIDATED DAMAGES

ORIGINAL CONTRACT AMOUNT		AMOUNT OF LIQUIDATED DAMAGES PER WORKING DAY
From more than:	To and including:	
\$ 0	\$ 50,000	\$ 200.00
50,000	100,000	250.00
100,000	500,000	450.00
500,000	1,000,000	650.00
1,000,000	2,000,000	800.00
2,000,000	and up	1,300.00

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the Owner of any of its rights under the Contract.

The Council may waive such portion of the liquidated damages as may accrue after the work is in condition for safe and convenient use by the public.

7.65 PROJECT ACCEPTANCE AND WARRANTY PERIOD

Final acceptance of the project by the Owner will be documented by the issuance of an acceptance letter, which is issued according to the following criteria:

- 1) Construction has been substantially completed and the facilities can be put to their intended use.
- 2) All testing has been completed, and the required results have been met.
- 3) A warranty bond, or other equivalent surety, in an amount equivalent to ten percent (10%) of the total cost of the project/improvement has been provided to the City to secure the warranty for a period of two years.

The date of the acceptance letter documents the start of the two-year warranty period, during which the Contractor/Subdivider/Developer shall be notified in writing of any defects in the project and shall submit to the Public Works Dept. a construction schedule to correct the defects at their expense within ten (10) days of receipt of the notice. Failure to correct or undertake, with due diligence, to correct the deficiencies within the specified time may cause the Owner to make the necessary repairs and bill the Contractor/Subdivider/Developer one and one-half (1 1/2) times the costs incurred; providing, however, that in case of an emergency, where, in the judgment of the Owner, delay would cause serious loss or damage, repairs may be made without notice being sent to the Contractor/Subdivider/Developer, and the Contractor/Subdivider/Developer shall pay the cost thereof.

The Owner reserves the right to extend the warranty period if excessive problems are apparent during the initial two-year period.

During a period of two years after the completion of the work covered by this contract and the final acceptance in writing thereof by the Owner, the Contractor shall make all needed repairs arising out of defective workmanship or materials furnished by the Contractor; or both, which in the judgment of the Owner shall become necessary during said period. The Owner is hereby authorized to make such repairs at the Contractor's expense, if within ten days after the receipt of a written notice to the Contractor, or his agent, the said Contractor shall neglect to make, or undertake with due diligence to make, the aforesaid repairs; providing, however, that in case of an emergency, where in the judgment of the Owner, delay would cause serious loss or damage, repairs may be

made without notice being sent to the Contractor and the Contractor shall pay the cost thereof.

7.66 RELEASE OF LIABILITY

No person, firm, or corporation other than the signer of this Contract as Contractor, now has any interest hereunder, and no claims shall be valid, and neither the Owner or any employee or agent thereof, shall be liable or held to pay any money except as herein provided. The acceptance by the Contractor of the payment shall operate as, and shall be a release to the Owner and every officer and agent thereof, from all claims and liability to the Contractor for anything done or furnished for or relating to the work or for any act or neglect of the Owner or any person relating to or affecting the work.

7.67 DETAIL DRAWINGS AND INSTRUCTIONS

The Engineer shall furnish with reasonable promptness, additional instructions, by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the Contract Documents.

Unless otherwise provided in the Contract Documents, the Engineer, if requested, will furnish to the Contractor, free of charge, five (5) copies of drawings and specifications necessary for the execution of the work. The Contractor shall pay the Engineer for the cost of printing any additional copies of drawings and specifications to be furnished by the Engineer and requested by the Contractor.

The Contractor shall keep one copy of all drawings and specifications on the work site, in good order, available to the Engineer and to his representatives.

The drawings, specifications, and copies thereof furnished by the Engineer are his property. They are not to be used on other work, and with the exception of the signed Contract set, are to be returned to him on request, at the completion of the work.

7.68 WAIVER OF RIGHTS

Neither the inspection by the Owner or Engineer or any of their employees, nor any order by the Owner for payment of money, nor any payment for, or acceptance of, the whole or any part of the equipment, material, or work by the Owner or Engineer, nor any extension of time, nor any possession taken by the Owner or its employees, shall operate as a waiver of any provision of this Contract, or of any power herein reserved to the Owner or any right to damages herein provided, nor shall any waiver of any breach in this Contract be held to be a waiver of any other or subsequent breach.

7.69 RAPID CITY UTILITY CONSTRUCTION CODE

Unless otherwise specified herein, all work done by the Contractor under this contract shall meet the applicable requirements of the Rapid City Utility Construction Code. A copy of this code may be obtained at the Engineering Department, 300 6th Street, Rapid City, South Dakota, at a cost of \$5.00 per copy.

7.70 PRECONSTRUCTION MEETING

Before the Contractor begins work under a City contract and before issuance of a Notice to Proceed, the Engineer will conduct a preconstruction meeting with the Contractor to establish project schedules and administrative requirements.

At the preconstruction meeting, the Contractor shall submit an acceptable written schedule, tentatively detailing the timing and sequence of major project components and showing critical construction activities and their interdependence. The Contractor, upon signing of the contract shall be required to furnish the Engineer a tentative schedule setting forth in detail the procedure he proposes to follow and giving the dates on which he expects to start and to complete separate portions of the work. If, at any time, in the opinion of the Engineer, proper progress is not being maintained, such changes shall be made in the schedule of operations as the Engineer shall direct or approve.

In addition, the Contractor shall submit a labor rate schedule for all anticipated personnel to be utilized on the project. The rate schedule shall be valid for the duration of the contract.

Submission of acceptable construction and labor rate schedules shall be a prerequisite for processing the first pay request.

The Contractor shall submit revised construction schedules periodically as directed by the Engineer to allow for changes in scheduling or whenever the present project status of critical path work items differs from the existing project schedule by more than one week. Revised schedules shall be submitted as a prerequisite for processing the subsequent pay request.

SECTION 8

WATER PIPING SYSTEMS

8.1 DESCRIPTION

A. General:

This work consists of furnishing and installing water mains, service lines, and appurtenances. This includes all equipment, tools, materials, labor, and other incidentals to provide water mains and service lines complete and ready for immediate and continuous use. The work includes, but is not limited to, all necessary excavation, backfilling, compaction, testing, clean up, and restoration required for a complete installation of water mains, service lines, and appurtenances.

B. Definitions:

1. Distribution main means a water main that supplies one or more branch mains.
2. Fire Service Line means pipe and appurtenances delivering water from the City water distribution system to a building fire extinguishing system. Fire service lines may be located on private property or in public ROW and are owned, operated, and maintained by the property being served.
3. Fire hydrant lead means that portion of the fire hydrant branch line from the main to the fire hydrant auxiliary valve.
4. "L" length for Joint restraining devices means the length of pipe from a fitting, valve, or feature that needs to have each pipe joint within that length restrained.
5. Private Fire Protection System means hydrants, valves, water pipes, and appurtenances, sprinkler systems, hose connections, and other equipment constructed for the purpose of providing fire protection for a building or group of buildings and supplied with water from a public water supply system. Private Fire Protection Systems are located on private property, although some components may be located in public ROW, and are owned, operated, and maintained by the property being served.
6. Transmission Main means a water main that supplies many tributary branches, serves a large area, and has few taps.
7. Water mains are those pipes of at least six (6) inches in diameter, which will be installed in public right-of-way or easements and will become a part of the City water distribution system and which will be owned, operated, and maintained by the CITY OF RAPID CITY.

8. Water service line shall mean the line from the main to within five (5) feet of the building and is owned and maintained by the owner of the property being served. The service line then connects to the Property Water Distributing System. For purposes of this definition, it is understood that the building or premises "Property Water Distributing System" begins 5 feet outside of the building and will usually be the same pipe material as the water service line up to where it actually enters the building.
9. Property Water Distributing System is those pipes within the building or the premises, which convey water from the water service pipe to the point of use. For purposes of this definition, the Property Water Distributing System begins 5 feet outside of the building and will usually be the same pipe material as the Water Service Line up to where it actually enters the building.

C. Related Work:

- Section 7 - General Conditions
- Section 9 - Sanitary Sewer
- Section 11 - Utility Excavation and Backfill
- Section 41 - Utility Trench Resurfacing
- Section 56 - Concrete for Incidental Construction (Class M)
- Section 90 - Traffic Control
- Section 112 - Select Granular Backfill
- Section 200 - Controlled Low Strength Material

D. License and Permit Requirements:

Refer to Section 11.

E. Submittals:

Submittals shall be required unless otherwise specified in the Detailed Specifications or Special Provisions. The term "Submittals" includes, but is not necessarily limited to, manufacturer's product data sheets of pipe, appurtenances, and fittings. Submittals shall be submitted for, but not limited to, the following items:

Fire hydrants, pipe, pipe fittings and their appurtenances including T-bolts, joint restraints, polyethylene encasement, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.

All submittals shall be made in accordance with Section 7.

Resubmittals shall be made in the same manner as submittals, with changes clearly shown.

8.2 MATERIALS

A. Pipe:

General: Pipe for water mains shall be Polyvinyl Chloride (PVC) or ductile iron with push on joints as specified on the plans or in the Detailed Specifications. Water pipe 18 in. and larger shall be ductile iron pipe unless indicated otherwise on the drawings or in the specifications.

1. PVC pressure pipe, 4 inches through 12 inches, shall conform to the requirements of AWWA Specification C-900, Class 150 or Class 200, (C.I.O.D.) and meet one of the below standards.
 - a. PVC pipe shall have bell ends with elastomeric gaskets. Pipe joints shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. Installation procedures shall conform to AWWA C-605 Standards or
 - b. PVC pipe shall be Certa-Lok C900/RJ Restrained Joint PVC Pipe manufactured by CertainTeed Corporation or equal. Pipe joints shall utilize non-metallic couplings with locking splines. High strength, flexible thermoplastic splines shall be inserted into mating, precision machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading. Couplings shall be designed for use at or above the pressure class of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F 477. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139. Every pipe and coupling shall pass the AWWA C900 hydrostatic proof test requirements of 4 times the pressure class for 5 seconds. Pipe and Couplings shall meet all approvals per Certa-Lok C900/RJ Restrained Joint PVC Pipe manufactured by CertainTeed Corporation and all pipe and couplings shall be marked in accordance with the requirements established for Certa-Lok C900/RJ Restrained Joint PVC Pipe manufactured by CertainTeed Corporation.
2. PVC pressure pipe, 14 inches through 36 inches, shall conform to the requirements of AWWA Specification C-905, Pressure Rated 165psi, DR 25 (C.I.O.D.) unless otherwise specified. PVC pipe shall have bell ends with elastomeric gaskets. Pipe joints shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. Installation procedures shall conform to AWWA C-605 Standards.
3. Ductile iron pipe shall conform to the requirements of AWWA Specifications C-150 and C-151, Pressure Class 350 for 3 inches through 12 inches diameter, Pressure Class 250, or greater for 14 inches through 20 inches diameter, and Pressure Class 200, or greater for 24 inches and larger diameter, unless specified otherwise on the plans or Detailed Specifications. Ductile iron pipe shall be coated on the outside with a bituminous coating 1-mil thick, minimum,

and shall be cement-mortar lined in accordance with AWWA Specification C-104. Linings shall be full thickness to the end of the spigot and to the seat of the bell, or shall be tapered for a length of not more than two inches.

Rubber gasket joints for all Ductile Iron pipe shall meet the requirements of AWWA C-111. Installation procedures shall conform to AWWA C-600 Standards.

4. Water service pipe 1 inch through 2 inches diameter shall be Type "K" soft copper tubing; 4 inches and larger service pipe shall be PVC or ductile iron pressure pipe as specified for water pipes, above.

Type K soft copper tubing shall be US Government Type K Soft Tubing in 60 – foot single or double pancake coils for 1 inch and 1 ½ inch diameter material. The minimum center coil diameter shall not be less than 16 inches.

Tubing material for 2 inches material shall be supplied in 20 – foot lengths with ends of tubing to be cut off evenly. Two (2) Inches coiled material will not be accepted.

Water service pipe larger than 2 inches shall meet the specifications above for PVC pressure pipe or ductile iron pipe.

B. Fittings:

1. Water main fittings:

General: Fittings used with ductile iron pipe shall be ductile iron. Fittings 12 inches and smaller, used with PVC pipe shall be ductile iron or PVC.

All bolts and nuts shall conform to AWWA C111 and ASTM – A325 Type 3. The bolts and nuts shall be Cor-Blue, fusion bonded epoxy, Series 300 stainless steel or approved equal. Coated bolts and nuts shall be “near white” or “white” metal with 8 to 10 mil minimum coating thickness. Fitting types applicable to this specification consist of bends, crosses, tees, reducers/increasers, plugs, caps, couplings, and sleeves.

- a. Ductile Iron water main fittings: Fittings shall be ductile-iron with 350-psi pressure rating and rubber gasket joints meeting all applicable requirements of the latest edition of AWWA C110, C111, and/or C153 Specifications. All internal and external ferrous surfaces shall be coated with a minimum 6 mil thick fusion bonded epoxy coating applied electrostatically and at a minimum shall meet the requirements of AWWA C116.

Unless specified otherwise on the plans or Detailed Specifications the following fitting joint shall be provided:

- Fittings 8 inches and smaller shall be push-on joint.
- Fittings 10 inch and 12 inch shall be push-on joint or mechanical joint. If the fitting is going to be restrained then it shall be a mechanical joint.
- Fittings 14 inches and larger shall be mechanical joint.

Push-on joint fittings shall be furnished with restraining lugs. The lug pattern for all sizes shall accommodate gripper-type restrainers.

- b. PVC water main fittings: PVC fittings maybe used in-lieu of ductile iron fittings for PVC pipe installations 12 inches and smaller. PVC fittings shall meet all applicable requirements of the latest edition of AWWA C900 Pressure Class 150 and AWWA C907. The PVC fitting bell ends shall have elastometric gaskets. Installation procedures shall conform to AWWA C-605 Standards.
- c. Couplings: Straight and transition couplings shall be Romac Style 501 as manufactured by Romac Industries, Inc., or equal and shall have ductile iron center rings and end rings meeting ASTM A536-80, Grade 65-45-12. Center rings shall be epoxy coated. Gaskets shall be SBR compounded for water service. Certa-Lok C900/RJ Restrained Joint PVC Pipe manufactured by CertainTeed Corporation or equal shall use non-metallic couplings specifically designed by the manufacture for use with their pipe. Couplings for 12 inch and larger pipe shall be a minimum 12 inches in length.
- d. Tapping Sleeves shall be ductile iron or stainless steel, flanged branch ends, with test plugs for pressure testing. The Sleeve shall be approved for use at pressures equaling or exceeding those of the pipe classification being installed. Ductile iron tapping sleeves shall be mechanical joint with totally confined end gaskets. Stainless steel tapping sleeves shall have a 304 stainless steel shell with SBR gaskets compounded for water service, a stainless steel flange, and shall have 304 stainless steel nuts, bolts, and washers.

C. Valves:

General: Valves 16 inches and smaller shall be gate valves and valves 18 inches and larger shall be butterfly type or gate valves as specified on the plans or detailed specifications.

All internal and external ferrous surfaces shall be coated prior to assembly with a minimum of 6 mils of fusion bonded epoxy coating applied electrostatically prior to assembly meeting the requirements of AWWA C550.

Additionally an exterior coating of Polyurea/Polyurethan Hybrid Resin per American AVK Company, or equal maybe added to the epoxy coatings required above.

Bolts and nuts shall be Cor-Blue, fusion bonded epoxy, Series 300 stainless steel or approved equal

1. Gate Valves shall conform to the requirements of AWWA Standard C509 and C515 with a 250-psi pressure rating and shall have a ductile iron-body and bonnet, be resilient seated, utilize mechanical joints including gaskets and bolts, and include all accessories. Gate valves shall have ductile iron wedge fully encapsulated with a SBR rubber or Nitrile elastomer coating. Stems shall be non-rising; one piece cast, forged or rolled bronze. Valves shall have two (2) inches ductile iron operating nuts and shall open left, counter clockwise. Bonnet bolts and nuts shall be Series 300 stainless steel and shall be rust proofed after threading and final tightening.
2. Butterfly Valves shall conform to the requirements of AWWA C504, Class 150B for buried installation. Butterfly valve box body and disk shall be ductile iron ASTM A-536. Shaft shall be stainless steel. Seat shall be Buna-N, field replaceable without special tools and shall provide tight shutoff as required by AWWA C504. Mating surfaces shall be stainless steel. Bearings shall be self-lubricating, corrosion-resistant, and shall be designed for horizontal and/or vertical shaft loading. Shaft seals shall be designed for the use of bi-directional, self-adjusting packing, replaceable without removing the valve shaft.

Actuator shall be designed for buried service and shall be grease-packed, totally sealed. Actuator shall be equipped with a mechanical stop-limiting device to prevent over-travel of the valve disc in the open and closed positions. Actuator shall be equipped with 2 inches operating nut, which is hex-mated to the input stem and shall open by turning counter-clockwise.

D. Valve Boxes:

1. Gate Valves 10 inches and smaller and Butterfly Valves:

Valve Boxes shall be Mueller 666-S or equal and shall be a 2-piece screw-type construction with five and one-fourth (5 1/4) inches riser and shall be adjustable from four and one half (4 1/2) feet to six (6) feet, with the top section to be at least 24 inches in length. Drop lids shall be marked "Water" and are to be of all-metal construction.

2. Gate Valves: 12, 14, and 16 inches.

Valve Boxes shall be Mueller 666-S or equal and shall be a 2-piece screw-type construction with five and one-fourth (5 1/4) inches riser and shall be adjustable from three (3) feet to four and one half (4 1/2) feet, with the top section at least 24 inches in length. Drop lids shall be marked "Water" and are to be of all-metal construction.

3. Valve Box Adaptor:

A valve box adaptor shall be installed on the valve bonnet prior to installing the valve box. The valve box adaptor eliminates shifting of the valve box, protects the coatings, centers the valve box, and seals the valve box with a resilient material. The adaptor shall be installed in lieu of hardwood blocking and shall be incidental to the valve box. The valve box adaptor shall be installed per the manufacturer's recommendations. The valve box adaptor shall be a "Valve Box Adaptor II" as manufactured by Adaptor Inc., a "Valve Box Self-Centering Alignment Ring" as manufactured by American Flow Control, or an approved equal.

E. Fire Hydrants:

Fire hydrants shall meet AWWA Standard C-502 and shall be Mueller A-423, American Darling B84B, American AVK Series 27, or Waterous WB-67 Pacer, traffic model with 6 ft. bury and 6 inches mechanical joint inlets. Hydrants shall have 5 ¼ inches minimum valve openings, having O-ring packings and oil chamber to hold soft oil for stem thread lubrication, and shall have all operating parts, including valve seat, removable through the barrel. Barrel and upper standpipe shall be ductile iron with breaker flange and operating stem at ground level. A steel breakaway coupling shall be installed on the operating stem so that in case of breakage, no damage will result to the fire hydrant other than safety breakers.

All internal and external ferrous surfaces shall be coated with a minimum of 6 mils of epoxy coating and at a minimum shall meet the requirements of AWWA C550 and AWWA C116 as applicable.

All external ferrous surfaces below the fire hydrant "bury line" including the fire hydrant riser (barrel) sections and adjoining 90 degree ells shall be coated with HB Fuller IF1947T Red Oxide Powder, Tnemec Series 140 Pota-Pox Epoxy or equal meeting the requirements of AWWA C550 and AWWA C116 as applicable.

Additionally an exterior coating of Polyurea/Polyurethan Hybrid Resin per American AVK Company, or equal maybe added to the epoxy coatings required above.

All exposed nuts and bolts below the breakaway (direct bury) shall be series 300 stainless steel.

All hydrants shall be capable of being extended in six (6) inches increments. However, the minimum hydrant adjustment shall be 12 inches.

Hydrants shall be constructed so that they will close with the existing water pressure acting on the hydrant. Drain valves shall be bronze and shall be positively operated by the main operating rod. All threads shall be National Standard threads. Operating nuts shall be 1 ½ inches point-to-flat, pentagon (National Standard). Hydrants shall open left, counter clockwise. Fire Hydrants shall have an internal travel stop nut.

Hydrants are to have two (2), two and one-half (2 1/2) inches nozzles and one (1) four and one-half- (4 1/2) inches steamer nozzle, all with National Standard threads. The minimum distance from the hydrant breaker flange to the centerline of the lower nozzle shall be sixteen (16) inches. Caps shall be nut type and shall be provided with chains. Hydrants shall be painted fire hydrant red.

All Fire Hydrants are to be ordered with barrel lengths of six (6) to eight (8) feet to facilitate their installation per the grades and lines shown on the drawings. Adjustments greater than eight (8) feet shall be accomplished using vertical bends (45, 22½, or 11¼) along the hydrant lead. The use of a Fire Hydrant Extension will not be an acceptable method of adjustment for a new Fire Hydrant, provided the necessary information was communicated on the drawings or specifications. If this information was communicated and the hydrant requires adjustment for final grade, then the Contractor shall replace the Fire Hydrant with a new Fire Hydrant with the correct barrel length or install the appropriate vertical bends on the hydrant lead.

In cases where a Fire Hydrant Extension will be installed, the Contractor shall furnish the appropriate extension and notify the City Utility Maintenance Department for installation. City crews shall install all Fire Hydrant Extensions.

F. Service Line Valves and Fittings:

General: Service line valves and fittings shall meet AWWA Standard C-800 and ASTM B26. All castings shall be 85/5/5/5 copper alloy.

1. Service line copper splicing couplings shall be flared or compression type such as Mueller 110 Conductive Compression, Hayes-Tite, or equal. Soldered joints shall not be used for service lines installed underground.
2. Curb stop valves shall be a "ball valve" type with a 300-psig working pressure rating. A double O-ring port seal shall be provided in the stem and the O-rings shall be supported in precision-machined grooves. The end pieces shall be O-ring sealed to provide additional protection against leaking. 90-degree valve operation, with internal movement restraint, is required. Drains are not permitted on valves. Buffalo type valve boxes are required and therefore the Minneapolis Pattern threads on the valve are not a requirement.

Copper pipe connections shall be Mueller 110 Conductive Compression, A. Y. McDonald McQuick Compression – Q Series, Hayes-Tite, or equal.

Curb stop valves shall be:

- "Mueller 300 Ball Curb Valve" with "Mueller 110 Conductive Compression Connection"; model B-25155,
- "A. Y. McDonald Minneapolis Pattern Ball Valves – 300 PSIG Water"; model 6104Q or 6100Q,
- Ford B44 Series,
- Or equal.

3. Corporation stops shall be a “ball valve” type with a 300 psig working pressure rating. The inlet shall have a taper thread (AWWA Standard) and the outlet shall be a conductive compression connection for type "K" copper. Copper pipe connections shall be Mueller 110 Conductive Compression, A. Y. McDonald McQuick Compression – Q Series, Hayes-Tite, or equal.

Corporation stops shall be:

- “Mueller 300 Ball” with “Mueller 110 Conductive Compression Connection”; model B-25008,
- “A. Y. McDonald Ball Valves – 300 PSIG Water”; model 4701BQ,
- Ford FB1000 Series,
- Or equal.

Corporation stops that are used to connect copper water services to metallic water mains shall be the isolator style or insulated corporation ball valve.

4. Service Saddles: Service saddles for 1 inch through 2 inches copper service pipe shall utilize a wide band/strap with a minimum of two (2) bolts and nuts, per width of the band/strap, for securing the band/strap to the main. The saddle shall provide full support around the circumference of the pipe. Nuts and bolts shall be rolled thread stainless steel or silicon bronze. Gaskets shall be neoprene or NBR compounded for water service.

- a. It shall be the Contractors responsibility to ensure that saddles and corporation stops are compatible with the pipe on which they are to be installed. If a compatibility question arises, the Contractor shall inform the Engineer and provide him with a recommended substitution.

- b. Saddles for 6 inch – 12 inch mains:

Saddles 6 inches – 12 inches mains shall utilize a stainless steel, cast brass per ASTM B62, bronze, or a high strength ductile iron body with a minimum 12 mils of fusion applied epoxy or Nylon 11 coating and a stainless steel band.

Saddles shall be pre-sized if required or recommended by the saddle or pipe manufacturer. Pre-sized saddles will conform to the pipe O.D. without placing undue stress on the PVC pipe. Not all of the following indicated saddles are presized and it is the responsibility of the Contractor and supplier to ensure that the saddle is presized if required or recommended by the saddle or pipe supplier.

Saddles for 6 inch – 12 inch mains shall be:

- 1 inch Service Taps:
Provide a minimum total band/strap width of 2 inches along the axis of the pipe. Saddles for 1 inch taps on 6 inches – 12 inches pipe shall be Ford Style FS303 or FC202, Romac Style 306, Style 202N and

202BS with SS straps, A. Y. McDonald Model 3845, Mueller DR2S series with double studs, or approved equal.

- 1½ inches & 2 inches Service Taps:

Provide a minimum total band/strap width of 3¼ inches along the axis of the pipe. Saddles for 1½ inches & 2 inches taps on 6 inches – 12 inches pipe shall be Ford Style FS303 or FC202, Romac Style 306, Style 202N and 202BS with SS straps, A. Y. McDonald Model 3845, Mueller DR2S series with double studs, or approved equal.

c. Saddles for 14 inch and larger mains:

Saddles for 14 inches and larger mains shall utilize a stainless steel, cast brass per ASTM B62, bronze, or a high strength ductile iron body with a minimum 12 mils of fusion applied epoxy or Nylon 11 coating and a stainless steel band.

Saddles shall be pre-sized if required or recommended by the saddle or pipe manufacturer. Pre-sized saddles will conform to the pipe O.D. without placing undue stress on the PVC pipe. Not all of the following indicated saddles are presized and it is the responsibility of the Contractor and manufacturer to ensure that the saddle is presized if required or recommended by the saddle or pipe supplier.

Saddles for 14 inch and larger mains shall be:

- 1 inch Service Taps:

Provide a minimum total band/strap width of 2 inches along the axis of the pipe. Saddles for 1 inch taps on 14 inches and larger pipe shall be Ford Style FC202, Romac Style 202N and 202BS, and Mueller DR2S, with SS straps, or approved equal.

- 1½ inches & 2 inches Service Taps:

Provide a minimum total band/strap width of 3 inches along the axis of the pipe. Saddles for 1½ inches & 2 inches taps on 14 inches and larger pipe shall be Ford Style FC202, Romac Style 202N and 202BS, and Mueller DR2S with SS straps, or approved equal.

5. Curb boxes shall be Tyler 6500 series, Mueller H-10350, Buffalo type, or equal and shall be cast-iron. The box shall be capable of telescoping, at a minimum, from five (5) feet to a length of six (6) feet. Lid shall be marked "water" and have a 13/16 inches (point to flat) pentagon brass nut. Risers shall be a minimum of two-and-one-half- (2 ½) inches in diameter.
6. Tapping sleeves and valves shall be used for service lines larger than 2 inches.

G. Concrete Thrust Blocks:

Thrust blocks shall be M-6 (4000 psi) concrete as specified in Section 56 of these specifications.

H. Joint Restraining Devices

1. Joint Restraint Devices at Fittings shall meet the following requirements:

In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated (min. 6 mils), utilize the "E Coat" coating system as specified by the Ford Meter Box Co., Inc., or utilize the "Mega-Bond" coating system as specified by EBBA Iron, Inc. All bolts, rods, etc. shall be COR-Blue, epoxy coated, stainless steel, or fluoropolymer coated per EBBA Iron, Inc. and the Ford Meter Box Co., Inc. specifications.

a. For DI pipe to DI push-on fittings:

Fitting Joint Restraints shall be EBAA Series 1100HD, or equal.

b. For DI pipe to DI MJ fittings:

Fitting Joint Restraints shall be EBAA MEGALUG Series 1100, Series 1100SD, or equal.

c. For PVC pipe to DI push-on fittings:

Fitting Joint Restraints shall be EBAA Series 15PF00, or equal.

d. For PVC pipe to DI MJ fittings:

Fitting Joint Restraints shall be EBAA Series 2000PV, Series 2000SV, Series 15PF00, or equal.

e. For PVC pipe to PVC push-on fittings:

Fitting Joint Restraints shall be EBAA Series 2500, or equal.

2. Joint Restraint Devices at pipe bells shall meet the following requirements:

In general, solid ring restraints shall be used whenever possible. Split restraints may be used when connecting to existing systems, for special cases, and when a solid ring restraint is not available for the application. All joint restraint devices shall be epoxy coated (min. 6 mils), utilize the "E Coat" coating system as specified by the Ford Meter Box Co., Inc., or utilize the "Mega-Bond" coating system as specified by EBBA Iron, Inc. All bolts, rods, etc. shall be COR-Blue,

epoxy coated, stainless steel, or fluoropolymer coated per EBBA Iron, Inc. and the Ford Meter Box Co., Inc. specifications.

- a. For ductile iron pipe:

The bell restraint shall be EBAA Series 1700, or equal.

In lieu of bell restraint devices, push on joints with the American Fastite Joint system with Fast Grip Gasket, or equal may be used when approved by the Engineer.

- b. For PVC C-900 pipe:

The bell restraint shall be EBAA Series 1600, or equal.

- c. For PVC C-905 pipe:

The bell restraint shall be EBAA Series 2800, or equal.

- I. Polyethylene Encasement:

Polyethylene Encasement (poly-wrap) shall meet AWWA C-105.

For ductile iron pipe, the encasement shall be 8-mil thickness, seamless tube, black ASTM D-1248, Type 1, Class C, Grade G-1. Joint tape for encasement shall be 3M Scotchwrap 50, or equal.

For fittings and joint restraining devices, which are not epoxy coated, the encasement shall be 8-mil thickness sheet polyethylene meeting AWWA C-105. Joint tape for encasement shall be 3M Scotchwrap 50, or equal.

- J. Pipeline Insulation:

Pipeline insulation shall be Type IV Styrofoam Brand—"Square Edge" or "Score Edge" as manufactured by Dow Chemical Company or approved equal shall be used for insulating water pipes where required. The total thickness and dimensions shall be specified on the drawings or in the Specifications. The minimum insulation thickness however shall be 2 inches.

Approved equal products from other manufacturer's shall be Extruded-Polystyrene Board Insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C578, Type IV, with 1.60 lb./cu. Ft. minimum density and a compressive strength of 25 lb./ sq. in as specified in ASTM D1622 and ASTM D1621 respectively. The maximum thermal conductivity of the insulation shall conform to ASTM C518, C177, and C578. The maximum water absorption percentage by volume shall be 1% in accordance with ASTM D2842. The range of water vapor permeance shall be 0.4 to 1.0 perm in accordance with ASTM E96.

K. Meter, Air Release, and Valve Pits:

Meter, air release, and valve pits shall be constructed in accordance with the detailed drawings and unless specified otherwise on the Drawings or Detailed Specifications, the pits shall be constructed in accordance with precast concrete manholes as specified in Section 9, Sanitary Sewer and modified as follows.

Meter, air release, and valve pits shall be provided with steps. Flat cover slabs, when required, shall be designed for HS-20 loading and shall have an offset 24 inches diameter hole in line with the manhole steps. Cones shall have an offset 27 inches diameter hole in line with the manhole steps. Standard frames and covers shall be "Neenah 1758 – E Frost – Retardant Frame and Lid w/ Inner Lid", or equal unless otherwise indicated on the drawings or specifications. The Lid shall be a diamond top design "Neenah Type C" un-marked.

Otherwise, the pit and casting shall meet the requirements of Section 9, Sanitary Sewer.

L. Tracer Wire System:

Tracer Wire shall be a direct bury wire that meets or exceeds the following requirements:

- a. Conductor: 12 AWG solid strand soft drawn copper per ASTM B-3, or B-8. The breaking pounds of the wire shall be a minimum of 124 with an O.D. of 0.154. All wire shall be spark tested at 7500 VAC.
- b. Insulation: Conductor shall be insulated with low density high molecular weight polyethylene insulation suitable for direct bury applications per ASTM D-1248. The minimum insulation thickness shall be 0.045. The color of the insulation shall be blue with a print line saying "WATER".
- c. Splices and or Connectors: Splices and or Connectors should be capable of handling from 2 to 4 wires per connector and designated as "water-proof". PVC adhesives or sealing compounds are not acceptable.
- d. Tracer Wire Access Box: Tracer wires shall be terminated using a small terminal box suitable for flush burial with a 2½ inches lockable cast iron top, integral stainless terminals and a minimum 12 in. ABS bottom section.
- e. Tracer Wire System Manufactures:
 - Tracing Wire – Kris Tech Wire Co. Inc., Paige Electric Corporation, or equal.
 - Splice Kit/Connectors -3M epoxy type compounds, fusible heat shrink tubing, 3M DBY connectors, or Snaploc LV 9000 direct bury wire connectors, or equals.

- Tracer Wire Access Box – Valvco Pipe Tracer Wire Terminal Box or equal.

8.3 CONSTRUCTION REQUIREMENTS

A. Materials Handling and Storage:

The Contractor shall be responsible for the safe handling and storage of all materials furnished by them and shall replace, at their expense, all such materials found defective in manufacture or damaged in transportation, handling, or storage.

Pipe, fittings, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. All material shall be stored in a neat and orderly manner. Pipe shall be stored, to the greatest extent possible, in unit packages or bundles and shall be handled to prevent stress to bell joints and prevent damage to bevel ends. In addition, materials shall be handled and stored in accordance with manufactures' recommendations.

If in the opinion of the Engineer damage or defects to the factory applied external coatings on steel or ductile iron pipe and fittings (including fire hydrants) can not be repaired, then the Contractor shall replace the damaged items with new materials.

If in the opinion of the Engineer damage or defects to the factory applied external coatings on steel or ductile iron pipe and fittings (including fire hydrants) can be repaired, then the Contractor shall make said repairs as follows:

If approved by the Engineer, the Contractor may make repairs when damage or defects occur in the factory applied external epoxy or "MEGABOND" coatings supplied on steel or ductile iron pipe and fittings (including fire hydrant risers and joint restraint devices). Coating repairs shall be made using a high build, low temperature applicable, fast cure, liquid epoxy coating. This epoxy coating material shall be Protal 7125 Repair Cartridge in packaged two component tubes with dispensing gun as manufactured by DENSO North America Inc.

When high ambient temperatures (i.e., > 85 degrees F) occur or when metal surface skin temperatures are high (i.e., > 100 degrees F) such that use of the DENSO Protal 7125 Repair Cartridge may be difficult due to the very short handling time of the material, an alternate modified amine cured epoxy coating may be used. This alternate coating shall be TC 7010 FS-Gray fast setting epoxy coating as manufactured by Tapecoat Co.

B. Alignment and Grade:

Pipe shall be laid true to the line and grade established on the Drawings. Where the Drawings indicate that the finished ground surface elevations are to be modified from the existing elevations by this or future construction, the Contractor shall exercise

care to ensure that pipe, fittings, hydrants, valves and valve boxes are placed to the elevations indicated on the plans.

C. Underground Obstructions:

The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed water main can be installed without the use of fittings at or near the points of crossing. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the pipeline, the Engineer will change the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstructions. The Contractor shall not deviate from plan line or grade without the Engineer's approval.

D. Water Main and Sewer Main/Storm Sewer Separation:

1. Vertical Separation at Crossings:

Water mains may cross above sanitary and storm sewers with a minimum vertical distance of eighteen (18) inches between the invert of the water main and the top of the sewer. In these cases where the water main is above the sewer and there is at least 18 in. of separation, then at the crossings one full 20 ft. length of water pipe shall be centered on the crossing.

The following installation requires Engineer's approval and is appropriate for installations where the water main cannot be constructed (18) inches above the sewer.

A water main may cross above a sewer main with a vertical separation of less than eighteen (18) inches or below the sewer main if either the water or sewer main is encased in PVC, ductile iron, or six (6) inches of "Controlled Low Strength Material" for at least ten (10) feet each side of the crossing. If PVC or ductile iron is utilized as encasement material, the ends shall be sealed with six (6) inches of Class M5 concrete.

The 10 feet each side of the crossing shall be measured from the outside wall of the sewer to the end of the encasement and is not measured from the centerline of the sewer main.

2. Water Main and Sewer Main/Storm Sewer Horizontal Separation:

Water mains shall be constructed with a minimum of 10 feet of horizontal separation from any existing sanitary or storm sewer or proposed sanitary or storm sewer. The 10 feet horizontal separation shall be the clear distance (water pipe sidewall to sewer pipe sidewall) and not the centerline distance between the utilities.

The following installation requires Engineer's approval and is appropriate for installations where the 10 feet separation physically is not possible.

A water main may be constructed closer than 10 feet to a Sanitary or Storm sewer if it is laid in a separate trench or it is laid in the same trench and the water main is located on the opposite side on a bench of undisturbed earth. In both cases, the elevation of the crown of the sewer has to be at least 18 inches below the invert of the water main. The sewer main shall be constructed of water main pipe (pressure class pipe) meeting the requirements of Section 8.2 and pressure tested for water tightness in accordance with AWWA standards for leakage testing.

As an alternative to constructing the sewer with water main pipe (pressure class pipe) and pressure testing the sewer, it would also be acceptable to either encase the water or sewer main with 6 inches of "Controlled Low Strength Material" or to encase either the water or sewer within a PVC or cast iron casing.

3. Manholes and Storm Sewers:

Sanitary Sewer Manholes and Storm Sewer Pipes and Inlets are considered to be sewers in regards to the above separation requirements.

A water main may be constructed below, within 10 ft. horizontally, and within 18" above a Storm Sewer pipe or Storm Sewer Inlet provided that the Storm Sewer pipe is constructed with sealed joints and passes a low-pressure (5psi) pressure test. The pressure test shall be maintained for a minimum of 30 minutes. The pressure test shall otherwise comply with the requirements of the "Low Pressure Air Test" in Section 9.3.H.4.a Sanitary Sewer.

The "Low Pressure Air Test" maybe waived by the Engineer for round RCP storm sewer utilizing O-ring gasketed joints as manufactured by South Dakota Concrete Products.

E. Installation:

1. Trenching shall comply with the requirements of Section 11, Utility Excavation and Backfill.
2. Minimum Cover depth from top of pipe to finished grade shall be as follows:

Size of Pipe (In.)	Minimum Cover (Ft.)
12 or less	6
14 to 18	5 ½
20 or larger	5

In the event adequate cover cannot be achieved by alignment or grade adjustment then, with prior approval of the Engineer, the water pipe may be insulated. Refer to the Insulation Standard Detail in cases where minimum cover cannot be provided. Insulation may also be required if adequate separation between a storm sewer or culvert and the water pipe cannot be achieved.

3. Cleaning shall be done as necessary so that the interior of all water pipe and fittings is free from all dirt, cement, or other foreign material before installation. Contact surfaces shall be wire brushed immediately prior to jointing.
4. Pipe Cutting shall be done without damage to the pipe with saw or abrasive wheel and shall be smooth, straight, and at right angles to the pipe axis. Ends of pipe shall be dressed and beveled to remove roughness and sharp corners.
5. Laying and Joining of PVC pipe shall be in accordance with AWWA C-900, AWWA C905, and AWWA C605, and with the pipe manufacturer's instructions. Laying and joining of ductile iron pipe shall be in accordance with AWWA C-600, Installation of Ductile-Iron Water Mains and their Appurtenances, and with the pipe manufacturer's instructions, unless specifically required otherwise by these Specifications. All Ductile Iron Water Mains shall be constructed with a Polyethylene Encasement tube as specified herein. The polyethylene encasement tube shall be secured circumferentially at 2 feet horizontal intervals with tape during installation.

Pipe shall be laid with bell ends facing in the direction of laying. Each pipe length shall be inspected for defects prior to being lowered into the trench. All pipe and fittings shall be carefully lowered into the trench piece by piece by means of pipe slings to prevent damage to the pipe and/or coating. Full lengths of pipe shall be installed except where connecting to appurtenances and fittings. The Contractor shall leave an appurtenance or fitting with a full length of pipe when ever possible.

Water main pipe shall not be installed in frozen ground or in water, and no water shall be allowed to run into or through the pipe.

During the course of construction, a suitable stopper shall be kept in the end of the pipe so as to prevent any dirt and or water from entering during the progress of the work at all times. Any dirt, loose material or cement mortar, which may accumulate in the pipe, shall be removed as the work progresses.

- a. Push-on Joints: The spigot end of field cut piping shall be cut square and then beveled. Joint surfaces shall be cleaned and lubricated immediately before completing the joint.
- b. Certa-Lok C900/RJ Coupling: Certa-Lok C900/RJ grooved end pipe shall be inserted into Certa-Lok C900/RJ couplings only. For use with PVC integral bells, push on fittings, or mechanical joint bells the pipe end shall be cut off at the groove and the pipe end beveled. Only insert plain end pipe into Certa-

Lok C900/RJ couplings outside of the restrained “L” length for the pipe system or utilize thrust blocking or other approved joint restraint devices.

- c. Mechanical Joints: Joints shall not be over-tightened; if an effective seal is not obtained the joint shall be disassembled, cleaned thoroughly and reassembled. Where joint restraint devices are used with a mechanical joint, the holes shall be carefully aligned to permit installation of harness bolts. At mechanical joints, a beveled PVC spigot may not be used. Rather a non-beveled spigot shall be used for insertion into mechanical joint.
6. Protection of the Work: Once in place, the pipe shall have its open end plugged to prevent soil, water, or other matter from entering the pipe.
7. Pipe Deflection: Deflection or bending of the pipe or deflection of the pipe joint (bell and spigot) shall not be permitted except as approved by the Engineer. Changes in horizontal and vertical direction shall be achieved using standard fittings, fabricated fittings, Couplings, and/or high deflection pipe couplings specifically designed and approved for use in joint deflection.

The Engineer may approve deflection of 12 inch diameter or smaller pipe or pipe joints if the “Engineer of Record” specifically designed for the deflection and the deflection is approved in writing by the pipe manufacturer specifically for the project. A condition of approval is the City of Rapid City receiving a letter from the pipe manufacturer stating they have reviewed the proposed pipe or pipe joint deflections for *(state the project name and City tracking number)* and they approve and warranty the pipe for the proposed deflections. Deflection of pipe or pipe joints for diameters greater than 12 inch is strictly prohibited.

Certa-Lok C900/RJ pipe and couplings maybe deflected in accordance with the manufacture’s written recommendations. The “Engineer of Record” shall specifically indicate the use of Certa-Lok C900/RJ pipe and indicate the designed deflections on the drawings.

8. Fittings: Bends and tees shall be placed on a stable foundation, which may require the use of concrete pads of equal size or larger than specified for valves. Fittings shall be provided with thrust blocks, joint restraining devices, and polyethylene encasement (where fittings which are not epoxy coated) as specified herein.
9. Couplings: Couplings shall be placed on a stable foundation and shall be wrapped in polyethylene encasement as specified herein. Couplings shall be approved by the pipe manufacturer for the use with the pipe and shall be installed according to the coupling manufacturer’s recommendations.
10. Thrust Blocks: Concrete thrust blocks shall be provided at tees, crosses, horizontal bends, plugs, caps, fire hydrants, and similar locations whether specifically indicated on the Drawings or not. Refer to the subsection “Joint

Restraining Device Installations” for situations and fittings that require the use of joint restraints in-lieu of concrete thrust blocks.

Concrete thrust blocks shall have a thickness at the fitting equal to at least half the diameter of the pipe being installed but shall not be less than six (6) inches thick under any circumstances. They shall extend from the fitting to the undisturbed wall of the excavation. The Contractor shall insure that the concrete does not cover or render inoperable nuts or bolts on the fittings. All metal fittings, valves, or appurtenances shall be wrapped in polyethylene prior to pouring thrust blocks.

Concrete Thrust blocks shall be allowed to cure for 48 hours prior to activating the water main. If the water main needs to be activated prior to the concrete curing (48 hours) then the water main shall be restrained using joint restraining devices. Prior to backfilling, thrust blocks shall cure for a minimum of four hours.

Thrust Blocks shall be installed as shown on the drawings and shall meet or exceed the minimum volume or bearing area requirements as specified on the drawings or specifications for the water pressures and soil conditions.

In muck, peat, or similar weak soils, thrust loads shall be resisted by using joint restraining devices or by removal of the soil and replacement with a material of sufficient stability to resist thrust loads as determined by the Engineer.

The use of Thrust Blocks, as specified above, is required when using Certa-Lok C900/RJ pipe and couplings.

Where prior approval of the Engineer is obtained, the Contractor may be able to substitute acceptable joint restraining devices for concrete thrust blocking. A condition of approval will be to address the potential corrosion issues associated with the use of joint restraints. The approval to substitute joint restraints is the Engineers decision and approval may or may not necessarily be granted even if the potential corrosion issues are addressed.

11. Joint Restraining Device Installations: Joint Restraining Devices are required for the following installations: Refer to Section 8.1 for the definition of “L” length for Joint restraining devices.
 - a. All Valves 12 inches and larger and pipe joints within their corresponding “L” lengths shall be restrained,
 - b. All High Pressure Valves (working pressures greater than 110 psi) and pipe joints within their corresponding “L” lengths shall be restrained,
 - c. Valves 10 in. and smaller placed on dead-end mains with less than 71 feet of pipe downstream of the valve shall be restrained using the appropriate “joint restraining devices” for a dead end. Both the upstream and downstream pipe joints within their corresponding “L” lengths shall be restrained.

- d. All Reducers/Increases and their corresponding “L” lengths shall be restrained,
- e. All Vertical Bends and pipe joints within their corresponding “L” lengths shall be restrained, and
- f. All Water Main Lowering and pipe joints shall be restrained.. Water Main Lowering restraint shall include restraining all joints within the fitting’s corresponding “L” length plus restraining all pipe joints which lie between the start of the lowering and the end of the lowering, regardless whether or not the pipe joint is located within the fitting’s “L” length.

All Joint Restraint Devices shall be double poly wrapped and taped per City Specifications for polyethylene encasement. If cathodic protection anodes are used, double poly wrap shall not be required. The polyethylene encasement ends shall be taped around the entire pipe diameter.

Joint Restraining Devices shall be installed per the manufactures’ recommendations and for the appropriate water pressures and soil conditions as shown on the drawings or specifications.

12. Tracer Wire: Tracer wire shall be installed along with all water pipes as described below:

The tracer wire shall be extended along with the water main. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be extended along all water main branches and hydrant leads as well. At fire hydrant leads two (2) tracer wires (the upstream tracer wire and the downstream tracer wire) shall be brought along the lead and brought to the surface at the fire hydrant. The upstream and downstream tracer wire at fire hydrants shall not be tied together as this is intended to allow independent tracing of the downstream and upstream main.

Tracer wire shall not be installed with copper water service lines.

Tracer wire shall be installed with PVC water services. Tracer wire installed with PVC service lines shall be installed in accordance with water main requirements except that the tracer wire shall be brought to the surface at a service line valve location. Do not connect the water service tracer wire to the tracer wire on the main. Tracer wire installed along service lines shall be independent of the tracer wire installed along the main. This allows for only tracing the service line. Each service line tracer wire installation shall have its’ own “Tracer Wire Access Box” installed at a service line valve location.

At locations where the PVC water service is not being replaced entirely, the contractor shall splice the new tracer wire to the existing tracer wire at the point

of reconnection. In instances where a PVC water service is not being replaced entirely and an existing tracer wire is not encountered, the Contractor shall coil approximately five (5) feet of wire at the reconnection location(s) to facilitate a future splice.

A Tracer Wire Access Box shall be installed at Fire Hydrants in all cases and when specified on the drawings at valve boxes or other locations. The Tracer Wire Access Box shall be centered 6 inches to 12 inches behind the fire hydrant. Both the upstream and downstream tracer wires shall be installed in the Tracer Wire Access Box. The tracer wires shall be taped to the Fire hydrant Barrel in at least five locations below the ground surface. The tracer wire shall be extended at least three (3) feet above the top of the Access Box, the wires connected to the Access Box lid, the wires folded, and inserted back into the Access Box for storage. The wire shall be easily retrievable for connection to and subsequent tracing.

All tracer wire connections shall be accomplished through the use of "pig-tails". All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connection by using an appropriately sized wire nut, and then preserving the splice or "pig-tail" by using a direct bury splice kit.

The main line tracer wire shall run continuous along the main(s) from fire hydrant to fire hydrant but shall not be continuous at fire hydrants. At fire hydrants two tracer wires shall be installed, one wire is the main line wire from downstream of the fire hydrant and the second wire is the main line wire going upstream of the fire hydrant. The main line tracer wire shall not be interconnected at the fire hydrant or at the main. This is intended to allow independent tracing of the downstream main from the upstream main and vice versa. Service line tracer wire shall not be connected to the main line tracer wire.

As a condition of project acceptance, Utility Maintenance Group personnel shall be able to successfully electronically trace all newly installed tracer wire/water mains. Utility maintenance personnel should be able to connect to tracing wires at every Fire Hydrant location and energize all water mains between that fire hydrant and the surrounding fire hydrants. The contractor is responsible for coordinating conductivity testing with Utility Maintenance personnel prior to finish surfacing activities. If the tracer wire does not function as intended, the contractor shall repair the system to the satisfaction of the Engineer.

The Engineer shall inspect all underground splices and "pig tails" prior to backfilling.

13. Insulation: Insulation shall be placed where noted on the plans. Insulation board shall be placed on a smooth and level cushion, minimum of 2 inches, of fine concrete aggregate (sand) and shall be covered with a minimum of 2 inches of the same material before placing bedding or backfill material on the insulation. The build-up of insulation sheeting shall be done by staggering the joints. An

acceptable adhesive may be used to retain the individual sheets in the final specified dimensions. The Engineer of Record or Contractor shall request to use insulation and obtain approval for use from the Engineer.

14. Fire Hydrants and Auxiliary Valves: Fire Hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the street, with the pumper nozzle facing the street. At intersections, the pumper nozzle shall face the higher classification street. Hydrants shall be set with the bottom of the breaker flange 2 inches above the finished ground elevation as shown on the Standard Details, resulting in the centerline of the lowest nozzle being at least 18 inches above finished grade. In no case shall hydrants be set closer than 4 feet from curb or edge of pavement, measured from outside of hydrant barrel to back of curb or edge of pavement. In cases where a fire hydrant needs to be rotated or an extension needs to be installed, City Utility maintenance staff shall perform the work.

The Contractor shall set each fire hydrant on a 8 inch x 12 inch precast concrete pad with a 4 inch thickness and shall place a minimum of 1/3 cubic yard of Type 2 Foundation Material around the lower part of the hydrant to at least six (6) in. above the drain port to provide a drainage area for the hydrant barrel. The Contractor shall insure that the drain port at the base of the hydrant is open to allow for the hydrant to drain properly when closed. Cast in place concrete may be used in lieu of the pre-cast pad if the hydrant lead is not charged for at least 48 hours and the drainage ports are maintained.

The hydrant barrel shall be poly wrapped to the ground surface and the poly wrap shall not cover up the weep holes.

An appropriately sized thrust block shall be installed between the hydrant valve chamber and the undisturbed trench wall. The thrust block shall meet the thrust block specifications herein.

An auxiliary valve matching the size of the fire hydrant lead and a valve box shall be installed on the fire hydrant lead. Auxiliary valves shall be installed as detailed on the standard plate and shall be placed on a precast concrete block, or shall be fitted with a joint restraining device as approved by the Engineer. Cast in place concrete may be used in lieu of the pre-cast pad if the hydrant and hydrant lead are not charged for 48 hours, and 4 hours cure time is allowed before backfilling. If the auxiliary valve needs to be moved away from, the fire hydrant to avoid a conflict it may be moved up to five (5) feet away from the hydrant.

Tracer wire conduit shall be attached to the fire hydrant barrel section prior to backfill. The Tracer Wire Access Box may be installed after initial backfill. Refer to the previous section for tracer wire installation requirements.

Refer to Section 8.2 "Materials" for further information regarding the use of hydrant extensions.

Fire hydrant lead shall mean that portion of the hydrant branch line from the main to the auxiliary valve.

15. Valves: Valve interiors and adjacent piping shall be cleaned of foreign material prior to making valve to pipe connection. Pipe/valve joints shall be straight and without deflection. All valves shall be encased in polyethylene per AWWA Standard C105 and as specified herein and shall be placed on a precast concrete anchor block and centered on the valve. Valves shall be backfilled with Type 1 bedding material to one (1) foot above the valve. The Contractor shall check all operating mechanisms for proper functioning; valves, which do not operate easily or are otherwise defective shall be replaced at the Contractor's expense.

Valves placed on dead-ends of mains with less than the required "L" length of pipe extending beyond the valve shall be restrained using the appropriate "joint restraining devices".

All Valves, which are not epoxy coated, shall be poly wrapped.

16. Valve Boxes: Valve boxes shall be installed straight and plumb directly over the valve stem and shall not be placed in direct contact with the valve. The top of the valve box shall be placed flush to ¼ inches below flush with the surfacing in paved or graveled areas and 1 inch - 2 inches above finished grade in grass surfaced areas. Where the Drawings indicate that the future grade at the valve location will be higher or lower than the existing grade at the time of valve installation, the Contractor shall provide the correct combination of extension pieces so that the valve box can be adjusted to the future finished grade without replacing the valve box.

A Valve Box Adaptor shall be installed on the valve bonnet prior to installing the valve box.

When shown on the drawings or specified, tracer wire shall be secured to the valve box section prior to backfill and a Tracer Wire Access Box" installed.

17. Tapping Tees for taps 4 inches and larger: Where new 4 inch or larger service lines or mains are to be connected to a main, the Contractor shall furnish all material necessary for connection to the water main, as specified herein. The tapping tee shall be assembled in accordance with the manufacturer's instructions. Tapping sleeves shall be supported independently from the pipe prior to tapping and shall be provided with thrust restraint as specified for other fittings. All tapping tees, which are not epoxy coated or non-corrosive material, shall be poly wrapped.

City Utility maintenance will perform all taps and the Contractor shall schedule all 4 inch and larger taps between 7:30 AM and 12:30 PM, Monday through

Thursday, or as alternately scheduled by the City Utility Maintenance Department.

The Contractor shall obtain and pay for all applicable permits and tapping fees. If a tap is for a 4 inch or larger service line reconnection, then the new account set-up fee will be waived.

18. Polyethylene Encasement: All buried metallic items including fittings, valves, valve boxes, fire hydrants, pipe, and accessories, shall be encased in 8-mil thickness sheet polyethylene per AWWA Standard C105. The polyethylene sheet shall be installed per AWWA C105 and taped. The polyethylene shall fully encase the fitting and appurtenances. Excess material shall be neatly trimmed away and all seams shall be taped. The transition between the polyethylene sheet and PVC pipe or the DI poly tube shall be accomplished by, sealing the ends of the sheet and taping the material fully around the circumference of the pipe. Cost of the encasement shall be incidental to the bid price of the fitting.

An exception to the polyethylene encasement requirement is when an anode cathodically protects the metallic item. In the case where the metallic item is protected by the use of an anode then the metallic item shall not be wrapped with polyethylene encasement.

19. Dewatering: Shall be accomplished per Section 11 Utility Excavation and Backfill.

F. Disinfection:

1. General:

Disinfection shall comply with the requirements of AWWA Standard C651, C605, and C600. All new water mains and appurtenances shall be disinfected before they are placed in service. All water mains taken out of service for inspecting, repairing, or other activity that might lead to contamination shall be disinfected before they are returned to service.

2. Preventative Methods:

The tablet method specified below may be used only if the pipes and appurtenances are kept clean and dry during construction. Therefore, the Contractor shall take precautions to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material.

If dirt enters the pipe, it shall be removed and the interior of the pipe surface swabbed with a 1%-5% hypochlorite disinfecting solution. If, in the opinion of the Engineer, the dirt remaining in the pipe will not be removed by flushing, the Contractor shall clean the interior of the pipe by mechanical means, such as a hydraulically propelled foam pig. Following mechanical cleaning the Contractor

shall flush the line achieving minimum flushing velocities of at least 30 ft/s and shall then disinfect the pipe using either the continuous-feed or the slug method. Flushing a completed main will not be allowed as a method of cleaning sediment allowed to enter the pipe during construction.

All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. If water accumulates in the trench, the plugs shall remain in place until the trench is dry. If, for any reason, the water main is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water until the main is clean. The section exposed to floodwater shall then be filled with a chlorinated potable water that, at the end of a 24-hour holding period, will have a free chlorine residual of not less than 25 mg/l. The chlorinated water shall then be flushed from the main and after construction is completed, the main shall be disinfected using the continuous-feed or slug method.

3. Disinfectant:

Unless specified otherwise in the Detailed Specifications or on the Drawings, or required by other provisions of this specification, disinfection shall be accomplished by the tablet method. The Contractor shall obtain the Engineer's approval prior to using a method other than the tablet method.

This method requires that the pipes and appurtenances be kept clean and dry. This method may not be used if the pipes and appurtenances are not kept clean and dry and in the event this happens, the Engineer must be contacted.

Tablets shall be 5-gram calcium hypochlorite tablets conforming to AWWA Standard B300 and shall contain between 65 and 70 per cent available chlorine. Tablets shall be fresh and shall be stored in a cool, dry, and dark environment to prevent loss of strength, which occurs upon exposure to the atmosphere.

Do not use calcium hypochlorite intended for swimming pool disinfection, as this material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

4. Dosage:

Unless otherwise specified, the Contractor shall place hypochlorite tablets in each section of water pipe installed, including the hydrant branch, according to Table 8-1, below.

Table 8-1
NUMBER OF 5-GRAM CALCIUM HYPOCHLORITE
TABLETS REQUIRED

(50 mg/l Dose)

Length of Pipe Section (Ft.)	Diameter of Pipe (In.)						
	4	6	8	10	12	14	16
13 or less	1	2	2	3	5	6	8
13 - 18	1	2	3	5	6	8	11
18 - 20	1	2	3	5	7	9	12
20 - 30	2	3	5	7	10	14	18
30 - 40	2	4	6	9	14	18	24

For Pipes 18 inches and larger refer to drawings or detailed specifications for disinfection requirements. The Engineer of Record is responsible for establishing the disinfection requirements for pipes 19 inches and larger.

5. Placing Tablets:

Tablets shall be adhered to the inside top section of each pipe length using a food-grade adhesive, such as Permatex Form-A-Gasket No. 2 or Permatex Clear RTV Silicon Adhesive Sealant as manufactured by Loctite Corporation. Adhesives shall meet the requirements of a food-grade adhesive per either NSF/ANSI 51-2005: Food Equipment Materials or NSF/ANSI 61-2005: Drinking Water System Components – Health Effects. NSF/ANSI 61 lists several adhesives that are approved for drinking water contact. It is recommended to use an adhesive that sets quickly and isn't reactive with the water main's composition or with the disinfectant tablet. There shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the pipe section to indicate the pipe has been installed with the tablets at the top.

6. Filling and Contact:

The water main shall be filled slowly so that the water velocity is no greater than one foot per second. Precautions shall be taken to assure that air pockets are eliminated. The water shall be allowed to stand in the pipe for at least 24 hours. Valves shall be positioned so that the strong chlorine solution in the treated main will not flow into water mains in active service. The chlorinated water shall remain in the pipe for at least 24 hours. The Contractor shall notify the Engineer at the end of the 24-hour retention period prior to flushing to allow the Engineer to check the chlorine residual in the pipe. If the chlorine residual is less than 25

mg/l, the Contractor shall, at his expense, disinfect the water main again by the continuous-feed method or the slug method, as approved by the Engineer.

7. Flushing:

Within 48 hours of the end of the 24-hour retention period, the Contractor shall flush the heavily-chlorinated water from the main until the chlorine concentration in the water leaving the main is no higher than that prevailing in the system or is less than 1 ppm as determined by the Engineer. In addition to the above requirements, a minimum flushing velocity of 3 feet per second and flushing duration of one minute per 100 feet of pipe being flushed shall be achieved per Table 8.2.

Flushing shall be done in accordance with AWWA C651. Flushing shall be accomplished through use of hydrants or temporary fittings installed for the purpose; flushing through corporations and/or water service lines is prohibited. The Contractor shall obtain the Engineer's approval prior to installing special fittings for flushing.

Flushing shall be conducted in such a way as to prevent contamination of existing water mains and/or water service lines and to minimize traffic and pedestrian hazards and nuisance conditions. When possible, flushing shall be to the nearest storm sewer or drainage way. Flushing to the sanitary sewer is prohibited.

The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact SD DENR Surface Water Quality Program at (605) 773-3351. Refer to section below, "Disposal of Chlorinated Water" for additional information regarding neutralizing chlorine residual.

A velocity in the main of at least 3.0 fps shall be attained during flushing. The flushing shall proceed until the chlorine concentration in the water leaving the main is no higher than that prevailing in the system or is less than 1 ppm as determined by the Engineer. In no case shall the flushing duration be less than that indicated in Table 8.2.

Table 8-2

REQUIRED FLOW AND MINIMUM FLOW DURATION TO FLUSH PIPELINES

Pipe Diameter (In.)	Flow required to produce 3.0 fps Velocity in Main* Gpm	Fire Hydrants		Minimum Flushing Duration (minutes per 100 feet of pipe)
		Number of Fire Hydrants	Outlet Size (In.)	
4	120	1	2-1/2	1
6	280	1	2-1/2	1
8	480	1	2-1/2	1
10	740	1	2-1/2	1
12	1100	2	2-1/2	1**
14	1450	2	2-1/2	1**
16	1950	3	2-1/2	1**

Table 8-2 shows the rates of flow required to produce a velocity of 3.0 fps in pipes of various sizes and the minimum flushing duration per 100 feet of pipe length

For pipes 18 inches and larger refer to drawings or detailed specifications for flushing requirements.

* Requires a minimum 40-psi pressure in the main and the hydrant flowing to atmosphere.

** Assumes that the corresponding flow rate is being met.

Per AWWA C651, the Contractor shall sample for coliform bacteria contamination. After the water lines have been flushed, the contractor shall sample the lines. Two consecutive samples of water from the end of the disinfected/flushed line must be collected at least 24 hours apart. These samples must be submitted to the State Health Laboratory in Pierre, or other laboratory acceptable to the SD DENR and the Engineer. The samples must show the absence of coliform bacteria contamination before any taps may be made to the main or the main is activated and placed into service. Copies of all sample results shall be submitted to the Engineer within 48 hours of receipt thereof.

Because of the high risk of contamination during sampling, the Contractor shall use certified lab personnel or a trained sampler to collect all samples submitted for testing.

8. Disposal of Chlorinated Water:

When, in the opinion of the Engineer or Contractor, the potential exists for chlorinated water to reach a stream, river, or waterway, the Contractor shall apply a neutralizing chemical to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water as listed in Appendix B of AWWA Standard C651. The Contractor will be responsible for any damage to fish and/or aquatic life caused by the chlorine residual. If Chlorine reaches or is detected in a stream, river, or other waterway the Contractor will be in violation for that discharge. For more information, contact SD DENR Surface Water Quality Program at (605) 773-3351.

G. Pressure and Leakage Test for Mains and service lines 4 inches or larger:

1. General:

Pressure and leakage tests shall be performed on all newly installed water mains. The "Simultaneous Pressure and Leakage Tests" will be used unless otherwise specified. The testing methods specified in this section are specific for water pressure testing only; air pressure testing is prohibited due to the catastrophic nature of failure should failure occur.

Refer to Section 8.3.D "Water Main and Sewer Main/Storm Sewer Separation" for air testing requirements for Sewers when a Sewer test is required because of horizontal separation requirements.

2. Test Restrictions:

The pressure shall be 150% of the working pressure at the point of test, but not less than 125% of normal working pressure at the highest elevation, whichever is greater. Test pressure shall not exceed pipe, valve, or thrust-restraint design pressures and shall not vary by more than 5 psi (plus or minus) for the duration of the test. The duration of the hydrostatic test shall be a minimum of two (2) hours.

The Contractor shall anticipate the need to conduct multiple tests in areas of varying topography and shall conduct testing in such a manner and sequence that the pressure requirements indicated above are achieved.

3. Pressurization:

Before applying the specified test pressure, each valved section of pipe to be tested shall be slowly filled with potable water and all air expelled from the pipe, valves, fittings, and hydrants. Where City water is not available, the Contractor shall furnish sufficient potable water to fill and test the pipe. The specified test pressure, based on the elevation of the lowest point of the section under test and corrected to the elevation of the test gauge, shall then be applied by means of a suitable pump connected to the pipe in a manner satisfactory to the Engineer and shall be sustained for the specified time.

The test pump shall be equipped with two (2) accurate pressure gauges, between the pump shut-off valve and water main being tested, both to show the line pressure reading during testing. When hydrants are in the test section, the test shall be made against closed hydrant valves. Pressure gauges shall have graduation marks, at minimum, for every 2 psi and be capable of interpreting pressure readings within 1 psi. The pressure reading deviation between the two pressure gauges shall not be greater than 2.0 psi. During the pressure test the pressure loss indicated between the two gauges shall not deviate more than 0.5 psi between the two gauges.

4. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five (5) psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by the drop in pressure for a test section over a period of time.
5. Allowable Leakage for PVC Pipe and Ductile Iron Pipe:

The PVC pipe shall be pressure and leakage tested in accordance with AWWA C605. The Ductile Iron pipe shall be pressure and leakage tested in accordance with AWWA C600.

No pipe installation, PVC pipe or ductile iron pipe will be accepted if the leakage is greater than that indicated in Table 8-3.

Table 8-3
ALLOWABLE LEAKAGE IN GALLONS
PER HOUR PER 1000 FT OF PIPE
(GPH)

Pipe. Dia. (in.)	Average Test Pressure (PSI)					
	50 psi (gph)	100 psi (gph)	150 psi (gph)	200 psi (gph)	250 psi (gph)	300 psi (gph)
4	0.19	0.27	0.33	0.38	0.43	0.47
6	0.29	0.41	0.50	0.57	0.64	0.70
8	0.38	0.54	0.66	0.76	0.85	0.94
10	0.48	0.68	0.83	0.96	1.07	1.17
12	0.57	0.81	0.99	1.15	1.28	1.40
14	0.67	0.95	1.16	1.34	1.50	1.64
16	0.76	1.08	1.32	1.53	1.71	1.87
18	0.86	1.22	1.49	1.72	1.92	2.11
20	0.96	1.35	1.66	1.91	2.14	2.34
24	1.15	1.62	1.99	2.29	2.56	2.81
30	1.43	2.03	2.48	2.87	3.21	3.51
36	1.72	2.43	2.98	3.44	3.85	4.21

6. Acceptance shall be determined on the basis of allowable leakage. If any test of installed pipe discloses leakage greater than that specified in Table 8-3, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. All visible leaks shall be repaired, regardless of the amount of leakage.

Any damaged or defective pipe, fittings, valves, hydrants, or joints discovered following the pressure test shall be repaired or replaced with approved material at the Contractor's expense, and the test shall be repeated until it is within the specified allowance.

7. Example - A pipe segment is required to be tested at 140 psi. At the start of the test, pressure gauge #1 indicates an initial pressure of 141 psi and pressure gauge #2 indicates an initial pressure of 143 psi. Both gauges are recording the test pressure within 2 psi and therefore the test may proceed. After completing the two-hour test duration, pressure gauge #1 indicates a pressure of 134 psi and pressure gauge #2 indicates a pressure of 136.5 psi. The pressure drop for pressure gauge #1 is 7 psi and the drop for pressure gauge #2 is 6.5 psi. The two gauges record a pressure drop within 0.5 psi of each other therefore the deviation of the pressure reading between the two gauges is acceptable.

If the pressure test had indicated a pressure loss of less than 5 psi then the "Pressure and Leakage Test" would have been considered as passing. Because in this example, the pressure loss is more than 5 psi, the Contractor may elect to re-pressurize the system and repeat the two-hour test or the Contractor may elect to measure the quantity of water required to pressurize the pipe segment so that the pressure loss is less than 5 psi. For this example if the quantity of water required to pressurize the pipe segment so that pressure gauge #1 indicates a pressure of 137 psi (loss of 4 psi) and pressure gauge #2 indicates a pressure of 137.5 psi (loss of 4.5 psi), is within the quantity of water allowed per Table 8-3 then the test would be considered as passing without having to repeat pressure test for two-hours.

H. Pressure and Leakage Test for Service Lines less than 4 inches:

Pressure and leakage tests shall be performed on all newly installed copper water service lines if the service line has one or more couplings installed between the corporation and the curb stop and/or one or more couplings installed between the curb stop and the Property Water Distributing System. The testing method shall be as specified in the National Standard Plumbing Code with the exception that air pressure testing is prohibited.

I. Water Main Closures and Temporary Service:

1. Water Main Closures shall be scheduled to minimize the inconvenience to the public. Consequently, water main closures shall be scheduled, between 8:00 A.M. and 4:00 P.M. Monday through Thursday, when possible. Short duration closures (closures scheduled to last no longer than two hours) may be scheduled on Friday between the hours of 8:00 AM and 11:30 AM.. Water main closures scheduled to begin prior to or continue beyond those times listed above, will require approval from the Engineer. In any case, water main closures will not be allowed until the Engineer gives his approval.

The Contractor shall obtain notification of closure cards from the Engineer and shall hand-deliver the closure cards to affected properties at least 48 hours prior to closure of any water main, unless a shorter time of notice is approved by the Engineer.

2. Operation of Valves: Only City personnel shall operate valves on existing water mains. The Contractor may operate valves on newly installed water mains that are under his control, until such time as, they are accepted by the City for operation and maintenance.
3. Temporary water service for private residences affected shall be provided by the Contractor when the water main closure will exceed eight (8) hours. The Contractor shall provide temporary water service for businesses upon request, regardless of the length of closure. When temporary service is to be provided to businesses, the Contractor shall obtain the name and phone number of a responsible contact person at each affected business and submit the information to the Engineer at least 48 hours prior to closure.

J. Abandonment and/or Salvage of Water Main and Appurtenances:

1. Water Mains:

The Contractor shall seal all open ends of water mains to be abandoned with a concrete plug having a length equal to the diameter of the pipe being plugged.

2. Fire Hydrants:

Fire hydrants and auxiliary valves are to be removed and salvaged, unless indicated otherwise on the drawings or Detailed Specifications, and shall be delivered by the Contractor to the City Utility Maintenance Shop on Steele Avenue in good working condition. Any damage to the hydrant and/or appurtenances as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

3. Valves:

Unless indicated otherwise on the drawings or Detailed Specifications, valves are to be removed, salvaged, and delivered by the Contractor to the City Utility Maintenance Shop on Steele Avenue in good working condition. Any damage to the valve as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

4. Valve Boxes:

The Contractor shall close the valve, remove and salvage the top sections of those water main valve boxes marked on the plans to be abandoned and shall deliver them to the City Utility Maintenance Shop on Steele Avenue. The resulting holes shall be backfilled and compacted to meet the requirements of these specifications and shall be resurfaced with the appropriate material; i.e. seed, sod, asphalt, concrete, etc.

5. Others:

When the drawings indicate items are to be removed or salvaged, the Contractor shall deliver the items to the City Utility Maintenance Shop on Steel Avenue in good working condition. Any damage to the items as a result of removing, salvaging, and delivering, shall be repaired by the Contractor at no cost to the City.

Unless an item is indicated as salvaged, the item will be considered a Contractor obligation to remove and dispose of.

K. Service Lines and Fittings:

1. Permits, obtainable from the City Utility Maintenance Division, will be required for all connections to the Rapid City water system.
2. Service pipe: Copper pipe shall be laid with sufficient waving as to prevent rupture in settlement. A "goose-neck" shape shall be constructed in the copper pipe leading from the corporation stop. Copper splicing couplings shall be as described in this specification. PVC and ductile iron service pipe shall be laid as specified herein for water mains. Minimum cover depth for water service lines shall be six (6) feet. A ten (10) foot horizontal separation shall be maintained between water service and sewer service lines. Tracer Wire shall be installed along with all PVC service lines, as described in the specification section relating to tracer wire. Tracer Wire shall not be installed with copper service lines.
3. Service saddles shall be installed for all connections to water mains. Unless specified otherwise on the Drawings or Detailed Specifications, the Contractor shall furnish and install all service saddles.

4. Corporation stops shall be provided by the Contractor, except for 1inch corporation stops, which the City provides. The Contractor shall communicate the water main material type to Utility Maintenance at the time a tap is requested. Corporation stops that are used to connect copper water services to metallic water mains shall be the isolator style. City personnel, in all cases will tap the main and install all corporation stops. If a Contractor is installing a copper water service on private property but is not replacing the service to the main and the copper water services connects to a metallic water main then an insulating union for copper water services shall be installed near the curb stop or at the location where the new copper connects to the existing copper. This is only required for copper water services connecting top metallic mains.
5. Service lines larger than 2 inches diameter shall be connected to the main with either an appropriately sized tapping sleeve and valve or a ductile iron tee as specified for water main fittings elsewhere in these specifications.
6. Curb stops and boxes shall be installed on all service lines and shall be located entirely within the public Right of Way. The curb stop and box shall be located between one and seven feet from the property line, unless otherwise approved by the Engineer. If any curb box is closer to the property line than 0.9 feet or farther from the property line than 7.1 feet, measured to the center of the box, then the box shall be reset to within the allowable tolerance. Curb boxes shall be installed straight and plumb directly over the curb stop. The top of the curb box shall be placed flush to ¼ inch below flush with the surfacing in paved or graveled areas and 1 - 2 inches above finished grade in grass surfaced areas. Where the Drawings indicate that the future grade at the cur box will be higher or lower than the existing grade at the time of installation, the Contractor shall provide a curb box that is applicable for the future finished grade without having to replace the curb box.

7. Water Service New Connections: Where new service lines are to be installed for undeveloped property or future buildings or additional services added to an existing building, the Contractor shall furnish all materials necessary for connection of new service lines to the water main, except 1inch corporation stops, as specified herein and shall obtain and pay permits and tapping fees as established by Ordinance.

Where the new service line is terminated, the service line shall be capped and plugged water tight to prevent leakage if the curb stop is inadvertently opened. New service connections shall have curb stops left turned off at the time of installation and the termination point shall be marked with a minimum three (3) foot long steel fence post. The steel post shall be buried below the surface at least eight (8) inches. The post needs to be steel to facilitate location by magnetic locators.

City personnel shall tap all city water mains, the Contractor shall schedule all service taps between 7:30 AM to 3:00 PM, Monday through Friday.

Water Service New Connections for service lines 4 inches or larger shall be made as described in the section for tapping tees.

8. Water Service Reconnections: The Contractor shall furnish all materials necessary for reconnecting service lines existing prior to reconstruction of a water main, except 1 inch corporation stops as specified herein. On City projects, all permits and tapping fees will be waived; however, the Contractor shall obtain a no-charge permit to work in the right-of-way from the City Utility Maintenance Group.

On non-City projects, the new account set-up / inspection permit (tap permit) will be waived however, the Right-to-Work permit and tapping fees are still applicable.

City personnel shall tap all city water mains, the Contractor shall schedule all service taps between 7:30 AM to 3:00 PM, Monday through Friday.

Water service reconnections for service lines 4 inches or larger shall be made as described in the section for tapping tees.

9. Inspection: All water service installations, regardless of whether or not the service is located on private property or in public ROW, shall be inspected by the City Utility Maintenance Group prior to the Contractor backfilling the trench. The Contractor shall notify the City Utility Maintenance Group a minimum of four (4) hours prior to the time he needs the inspection. Any trench backfilled without being inspected and approved by authorized City personnel shall be re-excavated by the Contractor to expose the work for the required inspection. Discrepancies shall be corrected by the Contractor and re-inspected by City personnel.

L. Acceptance of Curb Stops and Main Valves:

As a condition for project acceptance, all curb stops and water main valves within the project boundaries shall be in proper operating condition. City personnel will inspect and operate each curb stop and water main valve as part of the final inspection. The Contractor shall correct any deficiencies discovered during the inspection

8.4 METHOD OF MEASUREMENT

A. Water Main and Service Line Pipe:

Installed pipe quantities shall be determined by measuring from centerline to centerline of all pipe and fittings. Measurements shall be to the nearest whole foot.

B. Water Main Fittings and Couplings:

Fittings furnished and installed shall be counted on a per each basis. Measurement for concrete thrust blocks, cable and rods, and other thrust restraint will not be made; such work shall be incidental to the respective work item.

C. Valves:

Valves shall be counted on a per each basis. Valve boxes shall be included with the valves as a complete unit.

D. Fire Hydrant and Auxiliary Valve:

Fire hydrants will be counted on a per each basis. Auxiliary valve, valve box and pipe between the auxiliary valve and hydrant shall be included with the hydrant as a complete unit; no separate measurement and payment will be made for pipe between the auxiliary valve and the hydrant and for auxiliary valves and boxes.

E. Fire Hydrant Lead:

The water main pipe for the hydrant lead (branch) from the main to the Auxiliary Valve shall be paid for at the unit price bid for the appropriate size pipe.

F. Fire Hydrant Extensions:

Fire hydrant extension quantities shall be determined by measuring the vertical length of the extension. Measurement shall be to the nearest half foot.

G. Abandonments:

No separate measurement will be made for abandonment of water mains, valves and boxes, or salvaging hydrants, auxiliary valves and boxes; such work will be incidental to the project unless otherwise specified.

H. Water Service New Connections and Reconnections:

Water service reconnections and new water service connections will be counted on a per each basis.

The pipe used for reconnections and connections shall be measured and paid for under the bid item for water service pipe.

I. Service Saddles:

Service saddles furnished and installed will be counted on a per each basis.

J. Service Corporation Stops:

Service corporation stops furnished by the Contractor will be counted on a per each basis. No measurement will be made for service corporation stops furnished by the City.

K. Curb Stops and Boxes Installed, Adjusted or Abandoned:

Curb stops and boxes furnished and installed, adjusted, or abandoned will be counted on a per each basis.

L. Water Main Insulation:

Measurement for water main insulation will be made on a square foot basis to the nearest square foot.

M. Water Main Encasement:

Measurement for water main encasement will be made on a per each basis, furnished and installed, for each encased crossing with lengths as noted on the Drawings.

N. Thrust Blocks and Joint Restraints:

No separate measurement will be made for thrust blocks or joint restraint devices, such work will be incidental to the pipe.

O. Polyethylene Encasement:

No separate measurement will be made for polyethylene encasement such work will be incidental to the pipe and fittings.

P. Water meter pits:

Water pits furnished and installed will be counted on a per each basis.

Q. Tapping Tee (Includes sleeve and valve):

Tapping tees furnished and installed will be counted on a per each basis.

R. Tracer Wire, tracer wire access boxes, and all accessory items necessary for the installation of tracer wire shall be considered as incidental to the pipe installed.

S. Water Main Lowering:

Water main lowerings including, all materials, restraints, and low strength concrete for the complete installation shall be included in the bid item for water main lowering. Water main lowerings shall be counted on a per each basis.

T. Abandon valve:

Abandon valve shall be counted on a per each basis.

U. Adjust Valve Box:

Adjust valve box shall be counted on a per each basis.

V. New Water Main Connections:

New water main connections shall be counted on a per each basis. The bid item, New Water Main Connections, is intended for use where a tapping tee cannot be used and where an in-line tee must be cut into an existing main or where a cap/plug with thrust block must be removed prior to connecting.

8.5 BASIS OF PAYMENT

A. Water Main Pipe:

Payment will be at the unit price bid for the appropriate size of water pipe, furnished and installed, including trenching, excavation, Type 1 bedding material, compacting, backfilling, dewatering, sheeting or shoring, pressure and leakage testing, disinfection, and, for ductile iron pipe, polyethylene encasement. Unless otherwise specified, no extra payment will be made for excavation deeper than that required to provide minimum specified cover. The cost of providing temporary water service and plugging abandoned water mains shall be incidental to the project.

B. Water Main Fittings and Couplings:

Payment will be made at the unit price bid for the appropriate fitting, furnished and installed, including polyethylene encasement, and thrust blocks and/or restraints.

C. Valves:

Payment will be made at the unit price bid for the appropriately sized valve, furnished and installed, including valve box, polyethylene encasement, concrete pad, and thrust restraint.

D. Fire Hydrant and Auxiliary Valve:

Payment will be made at the unit bid price, complete, furnished and installed, including trenching, excavation and backfilling, dewatering, sheeting or shoring, and disinfection. The bid price shall include the auxiliary valve and box.

E. Fire Hydrant Extension:

When a fire hydrant extension is necessary due to no fault of the Contractor, as specified herein, payment will be made under the bid item for the fire hydrant extension per price bid. City personnel shall install all Fire Hydrant Extensions.

However, if the hydrant could have been installed or ordered with the correct barrel length such that an extension was not necessary, the Contractor shall furnish and install a new Fire Hydrant with the correct barrel length. Hydrant Extensions in these cases will not be permitted.

F. Abandonments:

No separate measurement will be made for abandonment of water mains, valves and boxes, or salvaging hydrants, auxiliary valves and boxes; such work will be incidental to the project.

G. Water Service Lines:

Payment will be made at the unit price bid for the appropriately sized pipe, furnished and installed, including trenching, excavation and backfilling, compacting, dewatering, and sheeting or shoring. The cost for any connections between the new service line and existing service lines shall be included in the unit price bid for the appropriate sized pipe.

H. Service Saddles:

Payment will be made at the unit price bid for the appropriately sized service saddle, furnished and installed.

J. Service Corporation Stops:

Payment for Contractor furnished corporation stops will be made at the unit price bid for the appropriately sized corporation stops. No payment will be made for one inch corporation stops, which shall be furnished by the City Utility Maintenance Group. The Utility Maintenance Group will also furnish one-inch isolator/insulated corporation ball valves when required.

J. Curb Stops and Boxes:

Payment will be made at the unit price bid for the appropriately sized curb stop and box, complete, furnished and installed.

K. Water Service New Connection:

Payment will be made at the unit price bid for connecting new water services up to two (2) inches in diameter to the new water main, including fittings necessary to connect the service line to the corporation stop. The cost of connecting water service lines two (2) inches or greater shall be included in the unit price bid for the fitting required to connect the service lines to the water main. Payment for Water Service New Connection shall include Right to Work permit, New Account Setup/Inspection permit (tap permit) and tapping fees, unless otherwise specified in the Detailed Specifications.

L.. Water Service Reconnection:

Payment will be made at the unit price bid for reconnecting existing water services up to two (2) inches in diameter to the new water main, including fittings necessary to reconnect the service line to the corporation stop. The cost of reconnecting water service lines two (2) inches or greater shall be included in the unit price bid for the fitting required to connect the service lines to the water main. On City projects, all permits and tapping fees will be waived. On non-City projects the New Account Setup/Inspection permit will be waived, however the Right-to-Work permit and tapping fees are still applicable.

M. Water Main Lowering:

Payment will be made at the unit price bid for lowering water main, including appropriate size pipe restraints, fittings, low strength concrete, and incidentals necessary to complete the work. Water main lowering shall be that, which is physically lowered vertically with the horizontal location not changed more than five (5) feet from original.

N. Water Main Encasement:

Payment will be made at the bid price, furnished and installed, including materials, temporary blocking and restraint of the pipe, and incidentals necessary to complete the work.

O. Water Main Insulation:

Payment will be at the bid price for water main insulation furnished and installed, including cushion material.

P. Meter Pit:

Payment for meter pits will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials, including castings, precast or cast-in-place floors, precast manhole sections, and incidentals necessary to complete the item.

Q. Tapping Tees:

Payment for tapping tees will be at the bid price per each including sleeve and valve, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item. The Contractor shall include payment for the "right to work" Permit, (tap permit), if applicable, and tapping fees in this bid item.

R. Abandon Valve:

Payment for abandoned valve will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

S. Adjust Valve:

Payment for adjusted valve will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

T. New Water Main Connection:

Payment for new water main connection will be at the bid price per each, complete and shall be considered full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the item.

U. Tracer Wire System:

Tracer wire, tracer wire access boxes, and all accessory items necessary for the installation of tracer wire shall be considered as incidental to the pipe installed.

END OF SECTION

SECTION 9

SANITARY SEWER

9.1 DESCRIPTION

A. General:

This work consists of furnishing and installing sanitary sewer mains, manholes, service lines, and appurtenances. This includes all equipment, tools, materials, labor, and other incidentals to provide sewer mains and service lines complete and ready for use. The work includes, but is not limited to, all necessary excavation, backfilling, compaction, testing, clean up, and restoration.

B. Definitions:

1. Collector sewer means a sewer main to which one or more branch sewers are tributary.
2. Interceptor sewer means a sewer that receives many tributary branches and serves a large territory.
3. Sanitary sewer mains are sewer pipes of at least eight (8) inches in diameter, which will be installed in public right-of-way or easements, will become a part of the City sewer system and will be owned, operated, and maintained by the CITY OF RAPID CITY.
4. Sanitary sewer service lines are the lines from the sewer main to within five (5) feet of the building and are owned and maintained by the owner of the property being served.
5. Private sanitary sewer collection system may consist of multiple sewer service lines and sewer collection pipes that are owned, operated, and maintained by the owner of the property being served.

C. Related Work:

- Section 7 - General Conditions
- Section 8 - Water Piping Systems
- Section 11 - Utility Excavation and Backfill
- Section 41 - Utility Trench Resurfacing
- Section 56 - Concrete for Incidental Construction (Class M)
- Section 90 - Traffic Control
- Section 112 - Select Granular Backfill
- Section 200 - Controlled Low Strength Material

D. License and Permit Requirements:

Refer to Section 11.

- E. Submittals shall be required unless otherwise specified in the Detailed Specifications or Special Provisions. The term "Submittals" includes, but is not necessarily limited to, manufacturer's product data sheets of pipe, manholes, appurtenances, and fittings. Submittals shall be submitted for, but not limited to, the following items:

Manholes, manhole frames and covers, pipe, pipe fittings and their appurtenances, and any other pertinent information concerning construction materials that the Engineer deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.

All submittals shall be made in accordance with Section 7. Resubmittals shall be made the same as for original submittals, with changes from the previous submittal clearly shown.

9.2 MATERIALS

A. Pipe:

Sanitary sewer pipe 21 inches in diameter and smaller shall be PVC unless indicated otherwise on the drawings or in the Detailed Specifications.

1. PVC pipe and fittings, 4 in. through 15 in. diameter, shall conform to the requirements of ASTM D-3034, Type PSM, SDR-35 (PS 46) minimum. PVC pipe 18 in. through 36 in. diameter shall conform to the requirements of ASTM F-679, PS 46. PVC pipe shall be manufactured in a continuous extrusion process employing a prime grade of un-plasticized PVC plastic material that meets the requirements for this product as specified in ASTM D-1784.

PVC Sewer Pipe shall have a flexible elastomeric seal (O-ring or rubber sealing elastomeric gasket joint), and conform to the latest revisions of ASTM D3212. Solvent cement joints will not be allowed for sewer pipe and fittings.

Nominal laying lengths shall not be less than 12.5 feet, except shorter lengths may be used adjacent to manholes. Each length of pipe shall be marked, as a minimum, with size, SDR, "Sewer Pipe" and ASTM number.

2. Reinforced concrete pipe (RCP) and fittings, in sizes 12 in. through 108 inches in diameter, shall conform to the requirements of ASTM C-76 and shall be manufactured using Type II cement. The pipe and fittings shall be manufactured at a precast facility that is certified by the American Concrete Pipe Association and is approved for supplying products to the South Dakota Department of Transportation. Class of pipe shall be as shown on the Drawings or specified in

the Detailed Specifications. Joints for RCP pipe shall meet the requirements of ASTM C-361 for concrete joints and confined rubber O-ring gaskets.

3. Ductile iron pipe shall be as specified for pressure pipe in Section 8, Water Mains. All ductile iron pipe shall be furnished with a ceramic Protectal 401 lining or equal. The lining shall have a minimum thickness of 40 mils. All ductile iron pipes shall be installed with polyethylene encasement in accordance with AWWA C105 unless otherwise directed by the Engineer. Ductile iron pipe thickness class shall be as specified on the drawings and/or in the specifications.
4. Sanitary Sewer Force Main:
 - a. Polyvinyl Chloride (PVC) Pipe and Fittings - Shall conform to Section 8 Water Piping Systems, subsection 8.2 Materials. PVC force main shall utilize a green dye resin for color in order to represent wastewater or a green locator ribbon with the word "sewer" stenciled shall be used.
 - b. Ductile Iron Pipe (DIP) and Fittings - Shall conform to Section 8 Water Piping Systems, subsection 8.2 Materials. In addition to meeting the above requirements all ductile iron pipe shall be furnished with a fusion-bonded polyethylene lining in accordance with ANSI/ASTM D1248. The lining shall have a minimum thickness of 60 mils. All ductile iron pipes shall be installed with polyethylene encasement in accordance with AWWA C105 unless otherwise directed by the Engineer. Ductile iron pipe thickness class shall be as specified on the drawings and/or in the specifications.
5. Sewer Service Pipe and Fittings - All pipe and fittings shall conform to the requirements of ASTM D-3034, SDR-35 (PS 46).

B. Miscellaneous Pipe Materials:

1. Pipe Couplings:

PVC repair couplings or clamp style couplings shall be used on all pipe equal to and greater than 8 inches in diameter. Clamp style couplings shall be "Power Seal Model 3541" as manufactured by Power Seal, Fernco-Strong back RC series repair couplings, or approved equal

Nonshear reinforced banded style couplings shall be as manufactured by DFW Plastics, Inc.; adjustable repair coupling with 300 series stainless steel shear ring as manufactured by Mission Rubber Company, Inc., PVC repair couplings, or approved equal shall be used on all pipe 6 inches in diameter or less. All couplings shall bear the manufacturer's identifying mark and size.

Reducing couplings will not be allowed.

Pipe couplings are incidental to the pipe or shall be considered as a subsidiary component to the bid item for connection to the sewer main.

2. Caps/Plugs:

PVC caps and plugs shall be the gasketed or solvent welded sewer fitting type. Caps and plugs for clay pipe shall be made using non-shrink grout placed continuously for a one-foot or one pipe diameter, whichever is greater, into the pipe.

3. Sewer Main Insulation:

Type IV Styrofoam Brand—"Square Edge" or "Score Edge" as manufactured by Dow Chemical Company or approved equal shall be used for insulating sewer pipes where required. The total thickness and dimensions shall be specified on the drawings or in the Specifications. The minimum insulation thickness however shall not be less than 2 inches.

Approved equal products from other manufacturers shall be Extruded-Polystyrene Board Insulation formed from polystyrene base resin by an extrusion process using hydrochloro-fluorocarbons as blowing agent to comply with ASTM C578, Type IV, with 1.60 lb./cu. Ft. minimum density and a compressive strength of 25 lb./ sq. in as specified in ASTM D1622 and ASTM D1621 respectively. The maximum thermal conductivity of the insulation shall conform to ASTM C518, C177, and C578. The maximum water absorption percentage by volume shall be 1% in accordance with ASTM D2842. The range of water vapor permeance shall be 0.4 to 1.0 perm in accordance with ASTM E96.

4. Polyethylene Encasement:

Polyethylene Encasement (poly-wrap) shall meet AWWA C-105.

For ductile iron pipe, the encasement shall be 8-mil thickness, seamless tube, black ASTM D-1248, Type 1, Class C, Grade G-1. Joint tape for encasement shall be 3M Scotch wrap 50, or equal.

For fittings, the encasement shall be 8-mil thickness sheet polyethylene meeting AWWA C-105. Off the shelf, polyethylene sheeting typically does not meet AWWA C-105. Joint tape for encasement shall be 3M Scotch wrap 50, or equal.

5. Sanitary Sewer Force Main Fittings, Valves, and ancillary items:

- a. Shall conform to Section 8 Water Piping Systems, subsection 8.2 Materials. In addition to meeting the above requirements the Tracer Wire specification shall be modified so that the wire insulation is green with a print line saying "SEWER".

C. Concrete Manholes:

1. General: Manholes shall be pre-cast reinforced concrete, manufactured using Type II cement, and shall have diameters as shown on the Drawings. The manholes shall be manufactured at a precast facility that is certified by the American Concrete Pipe Association and is approved for supplying products to the South Dakota Department of Transportation. Manholes 48 inches in diameter shall meet the current requirements of ASTM-C-478. Manholes with diameters larger than 48 inches shall have steel reinforcing that meets the requirements of ASTM C-76, Class 2. Upon request from the Engineer, the Contractor and/or supplier shall supply a test report from an independent testing laboratory showing compliance with this specification.
2. Manhole bases shall be integral (monolithic) with the barrel section and shall be cast to a minimum thickness of six (6) inches. When specified in the Detailed Specifications or shown on the Drawings, cast-in-place bases may be installed and shall have a minimum thickness of 8 inches with concrete conforming to the requirements of Class M6, Section 56. Cast-in-place bases shall incorporate a water stop between the base slab and manhole barrel. The water stop material shall be American Colloid "Water stop – RX", 1 in. x ¾ in. Size or equal.
3. Cone sections shall be eccentric type with 27 in. opening.
4. Flat cover slabs, when shown on the Drawings or specified in the Detailed Specifications, shall be designed for H-20 loading and shall have an offset 27 in. diameter opening.
5. Gasketed joints, joints between manhole sections shall be rubber gasketed joints conforming to the requirements of ASTM C443. Gasket types shall be either the O-ring style, the profile style, or approved equal.
6. Manhole joint sealant shall be pre-molded flexible butyl joint sealant conforming to Federal Spec. SS-S-210A and AASHTO M-198B and shall be ConSeal CS-302, or equal.
7. Manhole steps shall not be provided unless specifically noted on the drawings or specified in the Detailed Specifications. When steps are required they shall be plastic coated or rubber coated and conform to the requirements listed in ASTM C478 with an overall width of 12 inches and equally spaced vertically, however such vertical spacing shall not exceed 16 inches.
8. Lifting holes penetrating through the manhole sidewalls are not permitted.

9. If an interior lift system is used, inserts shall be grouted flush with the interior of the manhole after placement. Manhole lift system shall be "PressSeal Gasket Corp.", or equal and grout shall be a non-shrink grout.

10. Non-Shrink Grout shall conform to the following requirements:

Premixed compound consisting of no-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7000 psi in 28 days. Approved manufacturers are:

"Supreme Grout" – by Hanson Pipe and Products
 "Crystex" - by L & M Construction Chemicals
 "588 Non-Metallic, Non Shrink Grout" - by W.R> Meadows
 "Master Flow 713" – by Master Builders
 "Songgrout" – by Sonneborn
 "Five Star Grout" – by US Grout Corp. or approved equal.

11. Manhole Inverts shall be U-shaped with a channel depth equal to the diameter of the pipe exiting the manhole and with the channel sides vertical or slightly laid back at a slope not to exceed (1/10, horz./vert.) above the spring line, Refer to Standard Details. Manhole inverts shall be Class M-6 concrete per Standard Specification Section 56.

- a. New manhole benches and inverts shall be precast with the manhole. The same manufacturer that produces the precast monolithic base shall also produce the precast manhole inverts. Precast manhole inverts shall be per SD Concrete Product's Rapid City Plant or equal. Hand formed inverts will not be allowed for new manholes unless pre-approved by the Engineer.

The manhole invert shall have a smooth steel trowel finish and the bench shall have a broom finish.

- b. Existing manhole benches and inverts may be reconstructed with hand formed inverts and benches provided the other components of the specification are still met. The manhole invert shall have a smooth steel trowel finish and the bench shall have a broom finish.

12. Pipe Connections to new Manholes shall be constructed with a compression-type flexible connector cast into the manhole wall, as manufactured by A-Lok Products, Inc., or equal.

Alternatively shall be constructed with a boot-type flexible connector consisting of a rubber gasket or boot, metal expansion ring, and double metal take-up clamps, as manufactured by Press Seal Gasket Corporation, or equal. A stainless steel "power sleeve" shall be supplied for connecting the boot to the manhole. The boots shall be type PSX as manufactured by Press Seal Gasket Corporation or approved equal. Rubber boots and gasket material shall meet or exceed ASTM C-923.

13. Pipe Connections to Existing Manholes shall be made by coring the existing manhole and installing a boot-type flexible connector consisting of a rubber gasket or boot, metal expansion ring and double metal take-up clamps, as manufactured by Press Seal Gasket Corporation, or equal. A stainless steel “power sleeve” shall be supplied for connecting the boot to the manhole. The boots shall be type PSX as manufactured by Press Seal Gasket Corporation or approved equal. Rubber boots and gasket material shall meet or exceed ASTM C-923.

Alternatively, with Engineer’s approval the pipe connection may be made by cutting a hole into the manhole wall, fitting a water stop gasket over the pipe, placing a bentonite based water stop on the concrete manhole barrel (full circumference around the breakout), inserting the pipe, and grouting it into place. The bentonite based water stop shall be American Colloid “Waterstop – RX”, 1 in. x ¾ in. Size or equal. Refer to the specification section regarding “Construction Requirements” and the standard detail for further guidance with this installation.

14. Water stop gaskets for use in “Pipe Connections to Existing Manholes” shall be made of elastomeric PVC and be corrosion proof. For pipe connections 4 in. – 12 inches in diameter the water stop gasket shall be a “Concrete Manhole Adapter” as manufactured by Fernco, or equal. For pipe connections larger than 12 inches in diameter, the water stop gasket shall be a “Large Diameter Waterstops” as manufactured by Fernco, or equal.
15. Coating for Concrete Manholes and Lift Station Wet Wells: When indicated on the drawings or specifications a corrosion resistant interior grout liner shall be provided on manholes or lift station wet wells. The liner shall be “Kretekote 200” as manufactured by Kretekote LLC or equal. This product is specifically formulated for coating the interior of concrete manholes or wet wells for corrosion protection.

Coating color shall be the Earthcoat gray for manholes and Earthcoat white for wet wells unless otherwise indicated on the drawings or detailed specifications.

D. Manhole Frames and Covers:

1. All frame and covers shall be constructed with gray iron having a tensile strength of not less than 35,000 pounds per square inch. The frame and covers shall conform to ASTM A48, Class 35B. The castings shall be heavy-duty type, designed for H20 loading conditions. The castings shall be free from cracks, blowholes, porosity, shrinkage distortion or other imperfections. They shall be true to pattern and free from warpage. The frame and covers shall fit together in a satisfactory manner. Machined bearing surfaces shall be provided to prevent rocking and rattling. Manhole frames and covers shall be as follows.

- a. Standard frames and covers shall have a minimum casting height of seven (7) inches.
 - b. Standard frames and covers shall be Neenah 1733, Deeter 1260, Municipal Castings (MC) 301 or equal unless otherwise indicated on the drawings or specifications.
 - c. Extra deep frames and covers shall be installed where manholes are located in PCC pavement thicker than 7 inches. A casting height corresponding to or exceeding the PCC pavement thickness (up to 10 in.) shall be selected. Extra deep frames and covers shall be Neenah 1733-A; 1733-B; or 1733-C, Deeter 1261, or equal.
 - d. Bolt down frames and covers shall be installed as specified but will mainly be used in areas, which are without hard surfacing and are subject to flooding. Bolt down frames and covers shall be Neenah R1916F, Deeter 1247, or equal.
2. All covers shall be supplied with concealed pick holes as specified in the standard plates. All covers shall be marked with the letter "S" formed in the center of the cover. The cover style shall be a Neenah Type "k" Lid, indented top design or equal. All covers shall be supplied with self-sealing type "T" or O-Ring gaskets as manufactured by Neenah Foundry Company, machined groove continuous O-Ring gasket as manufactured by Deeter Foundry Inc., or approved equal. The covers shall be delivered from the manufacturer with pre-installed glued-in gaskets. The gasket shall be installed in a machined groove and be continuous around the perimeter. The gasket material shall be oil resistant Nitrile (60 DURO) glued in the groove, and have a maximum swell of 90 percent when tested in accordance with ASTM D471 using ASTM No. 3 oil. The glue shall be Lock-rite Black Max as manufactured by 3M Products or equal.

E. Manhole Adjusting Rings:

1. Concrete Adjusting Ring Materials:
 - a. Masonry bricks, masonry blocks, or masonry shimming devices will be allowed for use in adjusting manhole castings. Wood blocking or wood shimming devices greater than one inch in thickness will not be allowed. Any blocking or shimming device, when used, will not extend to the interior of the manhole.
 - b. Adjusting rings: Concrete adjusting rings shall be in accordance with ASTM C478. The adjusting rings shall be sized to conform to the standard manhole 27-inch cone opening, frame, and cover.
 - c. Mortar: Mortar shall be Standard Portland Portland_Cement Type 1, hydrated lime, and clean, sharp, well-graded sand, free from foreign materials. The minimum design compressive strength shall be no less than 4000 psi.
2. Plastic Adjusting Ring Materials:

- a. Sealant: Butyl Rubber Sealant in trowelable form shall be used. EZ-STIK #3 as manufactured by Pre-seal Gasket Corporation or approved equal. The material must meet or exceed the requirements of Federal Specification TT-S-001657, ASTM C-990 and AASHTO M-198.
- b. Plastic Adjusting Rings: The adjusting rings shall be injection molded HDPE as manufactured by Ladtech, Inc. or approved equal. The adjusting rings shall be manufactured from polyethylene plastic as identified in ASTM D-1248 (Standard Specification for Polyethylene Plastic Molding and Extrusion Materials). Material properties shall be tested and qualified for usage in accordance with the ASTM Test Methods referenced in ASTM D-1248. The plastic adjusting rings shall be manufactured utilizing the injection molding process as defined by SPE (Society of Plastic Engineers).

The adjusting rings shall be tested to assure compliance with impact and loading requirements in accordance with the AASHTO Standard Specification for Highway Bridges. The adjusting rings shall meet and exceed the static load requirements of ASSHTO highway Bridge Specification HS-25 (21,280 lbs). The rings must withstand 1,000,000 plus full load cycles of 10 seconds or less duration. The rings must perform without failure to a minimum of 150 percent of these load values. The adjusting rings shall be sized to conform to the standard manhole 27-inch cone opening, frame, and cover.

3. Rubber Adjusting Ring Material:

- a. Sealant: Sealant shall be polyurethane, formulated specifically for use with rubber adjusting rings and shall be manufactured by GNR Technologies, or approved equal.
- b. Rubber Adjusting Rings: Rubber adjusting rings shall be Infra-Riser multi-purpose rubber adjustment riser as manufactured by GNR Technologies, or approved equal

F. Manhole Internal Frame Seal: Manhole internal frame seals shall be installed with all manholes, unless pre-approved by the Engineer to be installed without a chimney seal. Manhole internal frame seals shall be CRETEX Internal Manhole Chimney Seals as manufactured by CRETEX Specialty Products, NPC Flexrib Seal, or approved equal. Internal frame seals shall consist of a flexible internal rubber sleeve and extension that completely covers all rings from cone to casting and stainless steel compression bands.

G. Tracer Wire System:

1. Tracer Wire shall be a direct bury wire that meets or exceeds the following requirements:

- a. Conductor: 12 AWG solid strand soft drawn copper per ASTM B-3, or B-8. The breaking pounds of the wire shall be a minimum of 124 with an O.D. of 0.154. All wire shall be spark tested at 7500 VAC.

- b. Insulation: Conductor shall be insulated with low density high molecular weight polyethylene insulation suitable for direct bury applications per ASTM D-1248. The minimum insulation thickness shall be 0.045. The color of the insulation shall be green with a print line saying "SEWER".
- c. Splices and/or Connectors: Splices and or Connectors should be capable of handling from 2 to 4 wires per connector and designated as "water-proof". PVC adhesives or sealing compounds are not acceptable.
- d. Tracer Wire System Manufactures:
 - Tracing Wire – Kris Tech Wire Co. Inc., Paige Electric Corporation, or equal.
 - Splice Kit/Connectors -3M epoxy type compounds, fusible heat shrink tubing, 3M DBY connectors, or Snaploc LV 9000 direct bury wire connectors, or equals.

9.3 CONSTRUCTION REQUIREMENTS

A. Wastewater Flow Modifications:

1. Interruption of Service: The Contractor shall provide continuous, uninterrupted sanitary sewer service to all users in and upstream of the project area.
2. Flow Handling Plan: Prior to beginning work on any manhole or sewer main requiring flow modification the Contractor shall present a plan for handling wastewater flows to the Engineer for his approval. The plan shall describe the methods to be used and shall identify all materials and equipment that will be required for flow handling. The Contractor's plan shall also identify a contingency plan and procedures to be implemented in the event of an equipment failure or other emergency.
3. Methods: Bypass pumping is required during construction hours and temporary connections, between existing and new sewer mains are required during non-working hours. Wastewater flows shall not be conveyed in open ditches nor in the trench excavation, and at no time shall wastewater be allowed on the ground surface, streets, gutters, storm sewers, or other places, which may constitute a health hazard.

Whenever, in the opinion of the Engineer, a health hazard exists because of actions or inactions of the Contractor, the Contractor shall immediately correct the situation to the satisfaction of the Engineer. If not corrected in a timely manner, the City may cause to take any actions necessary to remove the health hazard and charge the Contractor one and a half (1 ½) times the cost incurred.

4. Damages to Property: Any damages to private or public property due to backups, overflows, or surcharging resulting from work under this section shall

be the responsibility of the Contractor and shall be corrected as soon as practical and at no cost to the City. If not corrected in a timely manner, the City will take the necessary action and charge the Contractor one and a half (1 ½) times the cost incurred.

B. Materials Handling and Storage:

The Contractor shall be responsible for the safe handling and storage of all materials furnished by him, and shall replace, at his own expense, all such materials found defective in manufacture or damaged in transportation, handling, or storage.

Pipe, manholes, castings, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage. Under no circumstances shall such materials be dropped. All material shall be stored in a neat and orderly manner. Pipe shall be stored, to the greatest extent possible, in unit packages or bundles and shall be handled to prevent stress to bell joints and prevent damage to bevel ends. In addition, materials shall be handled and stored in accordance with manufactures' recommendations.

C. Underground Obstructions:

The Contractor shall expose existing underground obstructions shown on the plans or located in the field and shall determine their elevations far enough in advance of pipe laying that the proposed sewer main can be adjusted. Wherever obstructions not shown on the plans are encountered during the progress of the work and interfere with the proposed horizontal or vertical alignment of the sewer, the contractor shall notify the Engineer so that the Engineer may modify the plans and order a deviation in the line and/or grade, or may arrange for the removal or relocation of the obstruction(s). The Contractor shall not deviate from plan line or grade without the Engineer's approval.

D. Sewer Main and Water Main Crossings:

1. Vertical Separation:

Sewer mains may cross below water mains with a minimum vertical distance of eighteen (18) inches between the invert of the water main and the top of the sewer. In these cases, where the water main is above the sewer and there is at least 18" of separation, then at the crossings one full length of sewer pipe shall be centered below the water.

The following installation requires Engineer's approval and is appropriate for installations where the sewer main cannot be constructed (18) inches below the water.

A sewer main may cross below a water main with a vertical separation of less than eighteen (18) inches or above the water main if either the water or sewer main is encased in PVC, ductile iron, or six (6) inches of "Controlled Low

Strength Material” for at least ten (10) feet each side of the crossing. If PVC or ductile iron is utilized as encasement material, the ends shall be sealed with six (6) inches of Class M5 concrete.

The 10 ft. each side of the crossing shall be measured from the outside wall of the water to the end of the encasement and is not measured from the centerline of the water main.

2. Horizontal Separation:

Sewer mains shall be constructed with a minimum of 10 feet of horizontal separation from any existing water main or proposed water main. The 10 ft. horizontal separation shall be the clear distance (water pipe sidewall to sewer pipe sidewall) and not the centerline distance between the utilities.

The following installation requires Engineer’s approval and is appropriate for installations where the 10 ft. minimum separation physically is not possible.

A sewer main may be constructed closer than 10 ft. to a water main if it is laid in a separate trench or it is laid in the same trench and the water main is located on the opposite side on a bench of undisturbed earth. In both cases, the elevation of the crown of the sewer has to be at least 18 in. below the invert of the water main. The sewer main shall be constructed of water main pipe (pressure class pipe) meeting the requirements of Section 8.2 or equal and pressure tested for water tightness in accordance with AWWA standards for leakage testing.

As an alternative to constructing the sewer with water main pipe (pressure class pipe) and pressure testing the sewer, it is permissible to either encase the water or sewer main with 6 inches of “Controlled Low Strength Material” or to encase either the water or sewer within a PVC or cast iron casing.

E. Protection of Existing Sewers:

The Contractor shall take necessary precautions to ensure that dirt, debris, and foreign materials do not enter existing sewers. Where new sewer mains are to be extended from and connected to existing sewers, the Contractor shall give, the City Utility Maintenance Division 24-hour notice in order that City personnel may install a temporary plug at the terminal manhole on the existing sewer. Said plug shall remain in place until all work on the new sewer has been completed and the Engineer is satisfied that the new sewer is free of dirt, debris, and foreign materials. Any costs incurred by the City due to the Contractor allowing dirt, debris, foreign materials, trench water, or storm water to enter an existing sewer shall be charged to the Contractor at one and a half (1 ½) times the cost incurred.

F. Installation of Pipe:

1. Trenching, Bedding, and Backfill shall comply with the requirements of Section 11, Utility Excavation and Backfill. Trench dewatering discharges shall not be allowed to enter the sanitary sewer collection system at any time.
2. Alignment and Grade: Pipe shall be laid true to the line and grade established on the Drawings. Pipe shall be installed within 1/2 inch of the specified alignment and within 1/4 inch of the specified grade. These tolerances apply to any point along the entire pipe length.

The Contractor shall carry line and grade into the trench by means of an approved laser beam system and by surveying level instrument. At no time shall the Contractor change the grade without approval from the Engineer. If an underground obstruction is encountered at the assigned grade, the Contractor shall notify the Engineer and wait until the revised grade for the sewer has been determined, if necessary.

As a secondary check to the laser beam device, the Contractor shall check the grade from a surveyed grade stake to the pipe invert a minimum of every 100 feet using a surveying level instrument. The Contractor shall record all grade checks and produce the grade stake record if requested by the Engineer.

3. Cleaning shall be done as necessary so that the interior of all sewer pipe is free from all dirt, cement, or other foreign material before installation. Contact surfaces shall be wire brushed immediately prior to jointing.
4. Pipe Cutting shall be done without damage to the pipe with saw or abrasive wheel and shall be smooth, straight, and at right angles to the pipe axis. Ends of pipe shall be dressed and beveled to remove roughness and sharp corners.
5. Laying and Joining of pipes shall be in accordance with the pipe manufacturer's instructions, unless specifically required otherwise by these Specifications.
 - a. Each pipe length shall be inspected for defects prior to being lowered into the trench. All pipes shall be carefully lowered into the trench piece by piece by means of pipe slings to prevent damage to the pipe and/or coating.
 - b. Sewer pipe shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe.
 - c. Pipe shall be carefully installed to line and grade in accordance with line and grade stakes so that the finished sewer will present a uniform grade. Any noticeable variations from true alignment or grade will be cause for rejection of the work.
 - d. All pipe shall be installed upgrade with spigot ends pointing in the direction of flow. The bottom of the trench shall be freed of all rocks and stones and shall be hand shaped and bedded and the pipe shall be in firm contact with the bedding material for its entire length.

- e. At every bell and spigot pipe joint, a hole shall be dug of sufficient size so that the weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. All pipe must be properly fitted together.
- f. During the course of construction, a suitable stopper shall be kept in the end of the pipe to prevent any dirt and or water from entering during the progress of the work at all times. Any dirt, loose material or cement mortar, which may accumulate in the pipe, shall be removed as the work progresses.
- g. Standard length pipe shall be utilized for all installations. Shorter lengths will only be allowed for use at manhole terminations. A full standard length pipe shall be used upstream of all manholes.
- h. Joint surfaces shall be cleaned and lubricated immediately before completing the joint. Lubricant other than that furnished with the pipe shall not be acceptable. Pipe jointing shall be accomplished in a relatively dry trench condition.
- i. At manhole connections the Contractor shall take extra care to ensure the pipe is properly bedded to prevent shifting, settlement, deflection or other failures.
- j. Joints in PVC Sanitary Sewer Pipe:
 - 1) All PVC Sanitary Sewer Pipe shall be jointed utilizing elastomeric gaskets as specified. All pipe, fittings and joints shall be installed in full compliance with the recommended practices of the pipe manufacturer and as specified in the latest revision of ASTM D2321.
 - 2) The joint surfaces (external and internal) shall be wiped free of all foreign materials, and the spigot end shall be centered on grade into the bell end and the joint shall be properly seated in accordance with the manufacturer's recommendations.
 - 3) Any pipe that is field cut shall have a square end with beveled edge equal to a factory cut and all field repairs shall be performed per manufacturer's recommendations.
- k. Joints in Ductile Iron Pipe (DIP)
 - 1) All Ductile Iron Pipe shall be jointed utilizing a push-on type joint in accordance with the specifications. All pipe, fittings and joints shall be installed in full compliance with the recommended practices of the pipe manufacturer and the latest revision of the ANSI/AWWA C600 standard.

- 2) When making joints, the gasket and gasket seal inside the socket shall be wiped clean before the gasket is inserted. A film on lubricant shall be applied to the gasket and the outside of the spigot end of the pipe. The spigot shall then be positioned inside the socket and pushed home. Lubricant other than that furnished with the pipe shall not be acceptable.
6. Protection of the Work: At the end of each day's work, or when sewer pipe is not being laid, the Contractor shall protect the end of the pipe by a close-fitting stopper to prevent soil, water, or other matter from entering the pipe, and shall take adequate precautions to overcome possible uplift. The elevation of the last pipe laid the previous workday shall be checked the next day before work resumes.
7. Connections between new sewer main pipe and existing sewer mains shall be accomplished with a Fernco-Strong back RC series repair coupling, Power Seal coupling, or a PVC repair coupling. When using the Power seal or Fernco type installation, the Contractor shall encase the coupling in six inches of concrete for one foot either side of the coupling. PVC couplings do not require concrete encasement.
8. Minimum Cover depth from the top of pipe to finished grade shall not be less than 5.0 feet for Collector Sewers (sewer mains with service connections) or 4.0 feet for Interceptor Sewers (sewer mains with no service connections). In the event adequate cover cannot be achieved by alignment or grade adjustment then, with prior approval of the Engineer, the sewer pipe may be insulated. Refer to the Insulation Standard Detail in cases where minimum cover cannot be provided. The use of insulation shall only be permitted in those rare instances where the pipe's grade cannot be adjusted or the finished surfacing grade cannot be adjusted to maintain the minimum cover. Insulation may also be required in instances where adequate separation between culverts or storm sewers cannot be achieved.
9. Dewatering shall be accomplished per Section 11 Utility Excavation and Backfill.
10. Insulation: Insulation shall be placed where noted on the plans. Insulation board shall be placed on a smooth and level cushion, minimum of 2 inches, of fine concrete aggregate (sand) and shall be covered with a minimum of 2 inches of the same material before placing bedding or backfill material on the insulation. The build-up of insulation sheeting shall be done by staggering the joints. An acceptable adhesive may be used to retain the individual sheets in the final specified dimensions. The Engineer of Record or Contractor shall request to use insulation and obtain approval for use from the Engineer.
11. Sanitary Sewer Force Main:
- a. Sanitary Sewer Force Main - Shall conform to Section 8 Water Piping Systems, subsection 8.3 Construction Requirements.

- b. In addition to meeting the above requirements Tracer Wire Access Boxes shall be installed at a minimum of every 500 feet along the length of the force main. Each Tracer Wire Access Box shall be located such that it is easily locatable. In the event the Tracer Wire Access Box is located in remote turfed area then a marker Device consisting of a round pressure treated five (5) inch minimum diameter eight (8) foot fence post shall be installed next to the box so that 4.5 feet of the post is exposed. The exposed portion of the post shall be painted dark green to signify sanitary sewer.
- c. PVC force main shall utilize a green dye resin for color in order to represent wastewater or a green locator ribbon with the word "sewer" stenciled shall be used. The green locator ribbon shall be installed with ductile iron pipe. The locator ribbon shall be placed on top of the "select bedding material" approximately 12 inches above the top of pipe and centered horizontally directly over the pipe.

G. Installation of Manholes:

1. All manhole barrel and cone sections shall be numbered and/or measured by the Contractor prior to installation to insure that each furnished manhole component is correct for that location and that the finished manhole will be to the grade specified.

Placement of manholes shall be on a 4-inch (minimum thickness) leveling course of Type 1 Bedding Material. Manholes shall be set level and to the grade specified.

2. Invert Channels:

- a. General:

Channels shall have smooth, clean surfaces and shall be semi-circular U shaped conforming to the lower half of the adjacent pipe. Changes in size and grade of the channels shall be made gradually and evenly. In no case shall the invert width through the manhole be greater than that of the outlet pipe. Changes in direction flow and side branch connections shall be made with a full, smooth, and sweeping curve with a radius meeting the requirements per the Standard Details.

Manhole inverts shall be U-shaped with a channel depth equal to the diameter of the outlet pipe and with the channel sides, above the spring line, vertical or slightly laid back at a slope not to exceed (1/10, horz./vert.), Refer

to Standard Details. Manhole inverts shall be Class M-6 concrete per Standard Specification Section 56.

The manhole invert shall be shaped and finished with a smooth steel trowel finish.

b. Inverts for New Manholes:

Bench and inverts shall be precast or formed as specified in Section 9.2 Materials.

c. Inverts for Existing Manholes:

Existing manhole inverts to be reconstructed shall be as specified in Section 9.2 Materials and as further described.

All sewer flows shall be removed by bypass pumping or other approved methods from the manhole to be reconstructed. The existing invert and bench shall be demolished to the extent necessary to maintain a minimum new concrete invert thickness of 3 in. and side thickness of 8 in. throughout the manhole.

Acceptable methods for demolishing the existing invert include the use of concrete saws, jackhammers, chisels and other hand tools. The existing concrete shall be rough and have an approved bonding agent applied to it prior to placing the new concrete. The new invert shall be constructed using a concrete mix as specified with the exception that the concrete shall be low slump.

Sewer flows will not be permitted on the concrete until 4 hours after the initial set has occurred and the Engineer has inspected and approved the reconstructed invert.

4. Shelves/Benches shall be formed from the top of the channel to the manhole wall and shall slope up from the channel at a minimum rate of one (1) inch per foot and a maximum rate of three (3) inches per foot. The bench shall be constructed as specified in Section 9.2 Materials.
5. When specified/required, steps shall be inserted at least 1 in. into the manhole wall and shall be aligned straight and plumb over the outlet pipe in the manhole. Steps shall not be installed in manholes unless indicated on the drawings or in the specifications and approved by the Engineer.
6. Pipe Connections to New Manholes:

Manhole connections to the sewer main shall be accomplished with a rubber boot or a gasket seal that insures a watertight seal. Ends of pipes, which enter manholes, shall be cut smooth; straight; and at right angles to the pipe axis. The

annular space between the boot or gasket and the pipe shall be grouted flush with the inside of the manhole such that a smooth, continuous channel is formed through the manhole. The annular space above the flow channel on top of the pipe shall not be grouted.

Drop manholes shall have the lower connection and 45 degree fitting, outside the manhole, totally encased in concrete, Refer to Standard Details. The interior pipe connections shall have the annular space grouted as described above.

7. Pipe Connections to Existing Manholes:

a. Manhole connections shall be made by coring the existing manhole and installing a boot-type flexible connector consisting of a rubber gasket or boot, metal expansion ring and a metal take-up clamp, as manufactured by Press Seal Gasket Corporation, or equal. Rubber boots and gasket material shall meet or exceed ASTM C-923.

Drop manholes shall have the lower connection and 45 degree fitting, outside the manhole, totally encased in concrete, Refer to Standard Details. The interior pipe connections shall have the annular space grouted as described for "Pipe Connections to New Manholes".

Unless pre-approved by the Engineer, new pipe connections to existing brick manholes shall not be allowed. Brick manholes shall be replaced.

b. With Engineer's approval the Contractor may cut the necessary openings into the existing manhole and make the connection thereto in a neat and workmanlike manner. The connections shall be made to make the joints around the entering sewers watertight and an approved smooth channeled flow line shall be constructed as specified for Inverts.

The Contractor shall create a hole in the manhole wall using a chisel hammer or other approved method. The hole shall have a maximum dimension of 6 inches plus the O.D. of the pipe and a minimum dimension of 3 inches plus the O.D. of the pipe. Concrete saws are discouraged for cutting the hole as they leave cuts in the existing manhole wall and are difficult to grout shut. If a concrete saw is used, it shall be used in a manner such that there are no saw cuts left in the existing concrete.

The pipe shall be grouted into the manhole wall with non-shrink grout and a water stop gasket. The grout shall extend outside the manhole wall such that it provides a 6 in. overlap around the full circumference of the hole. The Contractor shall place a water stop on the concrete manhole barrel around (full circumference) the breakout, and grout it into place. The water stop shall be American Colloid "Waterstop – RX", 1 in. x ¾ in. size or equal. The grout shall also extend out/away from the manhole (around the pipe) for a length equal to the diameter of the pipe. Refer to the Standard Detail.

Drop manholes shall have the lower connection and 45 degree fitting totally encased in concrete. Refer to Standard Details.

b. After completing the connection to the manhole, the Contractor shall test the existing manhole for water tightness as required under the Section 9.3.1 - Manhole Tests. If the manhole does not pass the test it shall be the contractor's responsibility to correct the deficiencies and demonstrate a passing test. The Contractor is responsible for correcting deficiencies in the manhole even if said deficiencies preexisted or resulted from activities not directly related to the connection tie-in.

8. Frames and covers:

a. Grade and slope:

Manhole frames and covers shall be placed at finished grade. When placed in asphalt, concrete, or gravel surfaces, frames and covers shall match both the crown slope and profile slope of the street. The cover shall be set at an elevation and slope that it is not above the pavement surface and no more than 1/4 in. below the pavement surface at all points around the circumference of the cover. Decreasing the surfacing thickness around the manhole frame and cover, as a method of achieving the above tolerances, is not permitted.

Frames and covers placed in turfed areas shall be set from 1 - 2 inches above the finished grade.

Frames shall be blocked and shimmed to correct elevations and slopes prior to placing pavement. The lid shall be adjusted to match both the cross slope of the street and the profile of the street. Following paving, the frame shall be checked for correct placement and adjusted as necessary. The joint between frame and adjusting ring shall then be grouted watertight with non-shrink grout. Blocks and shims shall be placed no closer than 2 in. from the inside edge of the adjusting ring. The internal frame seal shall be installed after the manhole frame and cover has been installed in its final position and is complete.

Vertical Adjustment of manhole frames and covers:

Adjusting rings shall be installed per the Standard Details and as specified herein, adjustments greater than those shown on the details shall be accomplished by replacing or

adding additional barrel sections rather than adjusting rings.

Plastic or rubber adjusting rings may be used in lieu of concrete adjusting rings. The plastic or rubber adjusting rings shall be installed as recommended by the manufacturer. No shims or other leveling devices, other than leveling rings provided by the manufacturer, will be permitted with use of the plastic or

rubber adjusting rings. The annular space between the adjusting rings shall be sealed using an approved butyl rubber sealant, water stop material will not be permitted as it does not fully displace and further settlement of the frame occurs after installation. The first plastic adjusting ring on existing manholes may require leveling with concrete mortar and therefore the first plastic ring may be set in mortar.

The manhole frame and adjusting rings where concrete adjusting rings are used shall be set in a full bed of mortar to the grade and slope as specified. The mortar shall be tuck pointed between rings and shall not be applied to the inside diameter surface of the adjusting rings. Smearing of mortar on the inside of the adjusting rings will be cause for rejection of the work. When adjusting rings vary in thickness (2 in. & 4 in.) the larger ring (4 in.) shall be placed on top, directly under the frame.

1) New Manholes:

New Manhole barrels and cone sections shall be manufactured to a tolerance that provides from two (2) to eight (8) inches of vertical adjustment between the top of the cone and the bottom of the frame. Vertical adjustments, between the top of the cone and the bottom of the frame, greater than eight (8) inches shall be accomplished by installing a new appropriately sized manhole barrel section. Rings shall be vertically aligned to be straight with the top of the cone section without any offset.

2) Existing Manholes:

Existing manhole frames and lids may be adjusted to grade by adding additional adjusting rings. The vertical adjustment between the top of the cone and the bottom of the frame however shall not exceed 18 inches. Vertical adjustments, greater than 18 inches shall be accomplished by installing a new appropriately sized manhole barrel section. Rings shall be vertically aligned to be straight with the top of the cone section and with each other without any offset.

Steel adjusting rings that are inserted into the existing frame and allow the cover to be raised are not permitted. All manhole adjustments shall be done as specified above.

b. Chimney Seal:

Unless pre-approved by the Engineer, manhole chimney seals shall be installed in all cases. Whether an existing manhole is adjusted or a new manhole is installed, the manhole chimney shall be sealed. All manhole chimneys shall be sealed using a Manhole Internal Frame Seal. The seal shall be installed according to the manufacturers recommendations and when properly installed will prevent the inflow of water between the manhole cone and the frame and cover.

9. Coating for Concrete Manholes and Lift Stations Wet Wells: When indicated on the drawings or specifications a corrosion resistant interior grout liner shall be provided on manholes or lift station wet wells. The liner maybe field applied or applied at the manufacture's site. The liner shall be "Earthcoat 400P Pipe Coating" as manufactured by Earthcoat International, Appleton, WI or equal specifically formulated for coating the interior of concrete manholes or wet wells for corrosion protection. The material shall be applied as per manufacturer's recommendations. Manhole coating color shall be as specified in Section 9.2 Materials.
10. Manhole Depth: Manholes 5.5 foot and greater in depth, measured from invert to rim, shall have eccentric cone top sections per Standard Manhole Detail. Manholes less than 5.5 foot in depth shall have flat concrete covers designed for AASHTO H-20 wheel loading as per Standard Shallow Manhole Detail.

H. Sewer Main Tests:

1. General: A visual inspection, a TV inspection, a leakage test, and a pipe deflection test shall be performed as specified herein for all sewer mains and manholes as a condition of acceptance by the City. All tests shall be performed after backfill is complete but prior to any surface restoration.
2. Pre-Cleaning: Prior to testing newly installed sewer pipe, the Contractor shall remove all accumulated construction debris, rock, gravel, sand, silt, and other foreign matter from the sewer with an appropriately sized cleaning ball.

The Contractor shall be responsible for all work necessary to make the sewer acceptable for usage including removal of all mud, silt, rocks, or blockages that make said sewer unacceptable for final acceptance and usage. Also included is all work necessary in the manholes and all cleanup work required prior to final acceptance.

The City will not be responsible for cleaning lines prior to televising the sewer. In the event that the line is not acceptable for televising, due to the Contractor's operations, the Contractor will be notified. It will be the Contractor's responsibility to arrange to clean the sewer and make it acceptable for the television work. If not cleaned in a timely manner, the City may cause to take any actions necessary and charge the Contractor one and a half (1½) times the cost incurred.

3. Visual Tests: All newly installed sewer main pipe shall pass a visual, or "lamping", inspection by the Engineer, and a television inspection by the City Utility Maintenance Division. Straight alignment shall be checked either with lamping or with the laser beam. Lamping shall be conducted by viewing the pipe from inside a manhole to determine proper alignment. The television inspection

shall consist of viewing the inside of all sewer main pipe installed to determine proper alignment, joining, properly installed service connections, infiltration, etc. The Contractor shall correct, at his own expense, any defects discovered because of lamping and/or televising the pipe.

Both a visual and television inspection shall be completed unless specified otherwise in the Detailed Specifications or on the Drawings.

The expense of the initial television inspection and one additional reinspection will be borne entirely by the City. If defective workmanship of material or construction is noted, the Contractor at no expense to the City, shall correct the deficiency. The City will perform additional television inspections to review if the repairs were made properly and in accordance with the specifications. The expense of any additional television inspections beyond the initial inspection and one additional reinspection will be borne entirely by the Contractor. The Contractor shall be responsible for all related costs, including concrete or asphalt resurfacing if the street has been surfaced. The Contractor shall be required to repair all areas of infiltration and other deficiencies. The City may cause to take any actions necessary for any items not completed or repaired in a timely manner and may charge the contractor one and a half (1½) times the costs incurred.

It is the Contractors responsibility to notify both the Engineer/City Inspector and Utility Maintenance that the sewer is ready for inspection. From the time initial notification that the sewer is ready to be inspected the Contractor shall allow the City at least two (2) weeks to perform the television inspection. Any surfacing started prior to televising the sewer and said sewer being accepted is at the Contractors own risk.

4. Leakage Tests: The Contractor shall conduct leakage testing of all newly constructed or reconstructed sewer mains. The Contractor shall furnish all necessary equipment and be responsible for conducting the leakage test in the presence of the Engineer and/or project Inspector.

The preferred Leakage Test method is the "Low Pressure Air Test", provided groundwater conditions allow it. Alternative leakage tests may be the "Ex-Filtration Test" if groundwater is less than 4 ft. above the top of pipe, or the "Infiltration Test" if groundwater is 4 ft. or more above the top of pipe.

- a. Low Pressure Air Test: This is the preferred testing method. The Contractor may conduct low-pressure air testing of newly installed sewer mains in lieu of ex-filtration testing if the ground water is less than one (1) foot above the top of the finished sewer main at the lowest point of the test section as determined by construction records and/or test borings. The test shall conform to the procedures outlined in Uni-Bell Specification Uni-B-6-90 or latest, Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

The pressurizing equipment shall include a regulator or relief valve set no higher than nine (9) psig to avoid over-pressurization.

Pipeline segments between manholes shall be tested separately. Mechanical or pneumatic plugs shall be placed in the line at opposing manholes and each plug braced as a safety precaution. An aboveground air pressurizing device including shut-off valve, pressure-regulating valve, pressure relief valve, input pressure gage and a continuous monitoring pressure gage shall be provided and connected to the test plug at one end.

Separate hoses for introducing air and for monitoring air pressure shall be provided. The monitoring hose shall be equipped with two (2) accurate pressure gauges. The monitoring gages shall read in divisions of 0.1 psi with an accuracy of plus or minus 0.04 psi.

Procedure:

- 1) Clean the section of sewer line to be tested by flushing or other means prior to conducting the low-pressure air test. This cleaning serves to eliminate debris and produce the most consistent results.
- 2) Isolate the section of sewer line to be tested by inflatable stoppers or other suitable test plugs.
- 3) Connect the air hose to the inlet tap and portable air control source. The air equipment shall consist of necessary valves and pressure gauges to control an oil-free air source and the rate at which air flows into the test section to enable monitoring of the air pressure within the test section.
- 4) Low pressure air shall be introduced into the line until the internal pressure reaches four (4) psig, and the supply throttled to maintain four (4) psig for at least two (2) minutes. The supply shall then be shut off or disconnected. The pressure shall be allowed to drop to about three and one-half (3 1/2) psig at which time the timing shall commence and the time accurately measured for a one (1) psig pressure drop per Table 9-1.

If the test section fails to meet these requirements, the Contractor shall, at his own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does not mean that the Low Pressure Air Test has to be repeated but rather a passing test has to be achieved by either the Low Pressure Air Test or the Ex-filtration Test.

- 5) Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

TABLE 9-1 *
LOW PRESSURE AIR TEST
ALLOWABLE LEAKAGE FOR A 1 PSIG PRESSURE DROP

Pipe Diameter	Time of Test (sec.'s)	Minimum Time of Test (sec.'s)
4	0.380 x L	226
6	0.854 x L	340
8	1.520 x L	454
10	2.374 x L	566
12	3.418 x L	680
15	5.342 x L	850
18	7.692 x L	1020
21	10.470 x L	1190
>21	as per plans	

* Use of Table 9-1:

The time of test shall be calculated using the formula presented in Table 9-1. Time is in seconds and L is in feet of pipe being tested. If the calculated time is less than the minimum time of test then the minimum test time shall govern. For example: a 200 ft. - 10 in. sewer would have a calculated time of $2.374 \times 200 = 475$ seconds. The minimum test time however is 566 seconds. Thus the minimum length of time for a 1 psig pressure drop would be 566 seconds not the calculated 475 seconds.

If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test considered.

- b. Ex-filtration Test shall be used if groundwater is less than 4 ft. above the top of pipe as determined by construction records and/or test borings. The test shall be conducted in a manner approved by the Engineer and shall provide a minimum head of two (2) feet at the highest point in the test section, but no more than 10 feet of head at the lowest point, with head measured from top of pipe, except when the groundwater surface is above the pipe, in which case head shall be measured from the groundwater surface.

Unless otherwise specified, the pipe shall not allow ex-filtration, of water, of more than 50 gallons per inch diameter per mile of pipe (50 gal./in./mi.) in any 24-hour period as per Table 9-2.

The minimum test period shall be for two (2) hours and the values derived from Table 9-2 will need to be adjusted for the actual test time. If the test section fails to meet these requirements, the Contractor shall, at his own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does not mean that the Ex-filtration test has to be repeated but rather a passing test has to be achieved by either the Ex-filtration Test or the Low Pressure Air Test.

It is not recommended to conduct the pipe leakage test concurrently with the manhole ex-filtration test, as the allowable parameters for head (H) in the two tests differ. However, a separate manhole ex-filtration test will not be required when manholes are tested simultaneously with the sewer pipe ex-filtration test.

The Contractor shall anticipate the need to conduct multiple tests in order to meet the above requirements and shall conduct testing in such a manner and sequence that the requirements indicated above are achieved.

Water used to test ex-filtration shall be clean potable water and will not be allowed to discharge to the sewer system. Such water shall be pumped from the system and discharged at an approved location.

**TABLE 9-2
ALLOWABLE LEAKAGE ***

PIPE SIZE (In.)	LEAKAGE RATE (Gal./Ft./24 Hrs.)
8	0.08 x L
10	0.09 x L
12	0.11 x L
15	0.14 x L
18	0.17 x L
21	0.20 x L
24	0.23 x L
27	0.26 x L
>27	as per plans

* Use of Table 9-2:

The length of time for the test in the table is given as a 24-hour period and will need to be adjusted for the actual test time. The allowable leakage shall be calculated using the formula presented in Table 9-2 and L is in feet of pipe being tested.

It is not recommended to conduct the pipe leakage test concurrently with the manhole ex-filtration test, as the allowable parameters for head (H) in the two tests differ.

If the Contractor wishes to concurrently test the pipe and manhole then Table 9-4 may be used to assist in measuring the pipe loss for a concurrent test.

For example the calculated loss for 350 ft. - 12 in. sewer would be $0.11 \times 350 = 38.5$ gals in a 24-hour period. To adjust this loss to the actual test time or if a manhole test is being conducted concurrently the 38.5 gals would need to be converted, to say, two (2) hours; then $(38.5 / 24 \text{ hrs}) \times 2 \text{ hrs} = 3.2$ gals. The 3.2 gals would be the permitted loss or if

testing concurrently would have to be added to the loss calculated for the manhole.

- c. Infiltration Test shall be used if ground water is four (4) feet or more above the top of the finished sewer main at the highest point of the test section as determined by construction records and/or test borings. Test methods and infiltration measurements shall be conducted in a manner approved by the Engineer.

The allowable leakage from the pipe shall not exceed that set for Ex-Filtration in Table 9-2. The minimum test period shall be for two (2) hours and the table values will need to be adjusted to accommodate for the actual test time. If the test section fails to meet these requirements, the Contractor shall, at his own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does mean that the Infiltration test has to be repeated as the other test methods would not be permitted because of the groundwater conditions.

5. Pipe Deflection Test:

Deflection tests shall be performed by the Contractor on all PVC sewers. Deflection tests will not be required for reinforced concrete pipe sanitary sewers. Deflection tests for other sanitary sewer pipe materials will be handled on a case-by-case basis by the Engineer. Deflection tests shall be conducted after the final backfill has been in place at least 30 days. Deflection tests shall be made using a deflection gauge (mandrel) device or other approved method. The diameter of the deflection gauge device shall be 95% of the undeflected inside diameter of the flexible pipe. The deflection test shall be performed without mechanical pulling devices. The Contractor shall be required to install the pipe in such a manner so that the diametric deflection of the pipe shall not exceed five (5) percent. All pipes exceeding the five (5) percent deflection within the two-year warranty period shall be re-laid or replaced by the Contractor at no additional cost to the Owner.

I. Manhole Tests:

General: Manhole tests shall be performed on all newly installed manholes and on existing manholes where new sewer main connections have been made. The preferred Manhole Leakage Test method is the "Manhole Vacuum Test" rather than the "Ex-Filtration Test".

- 1. Visual Test: The project Engineer/Inspector will visually inspect each manhole exterior and interior for flaws, cracks, holes, or other deficiencies, which may affect the operation or watertight integrity of the manhole. Should any deficiencies be discovered, the Contractor shall correct them to the satisfaction of the Engineer and at no cost to the Owner. Manhole barrels and cones that have cracks or holes that extend from the interior of the barrel

or cone to the exterior shall be replaced. Manhole barrels or cones that have spalls or cracks that extend to or through the O-ring gasketed joint shall be replaced. For other deficiencies or flaws the Contractor may submit to the Engineer a written repair procedure for consideration. The Engineer may or may not permit the proposed repair method and by allowing a repair method does not, in anyway, remove or alleviate any testing requirements.

2. Manhole Vacuum Test shall be performed in accordance with ASTM C1244. The following procedure is summarized from ASTM C1244 and shall be followed in conjunction with ASTM C1244 unless modified by the Engineer. The vacuum test shall include testing the top of the manhole, excluding the adjusting rings and manhole frame and cover. Testing will be allowed after backfilling has occurred, manhole vacuum tester assembly and vacuum pumps shall be as manufactured by Cherne Industries, Inc. or approved equal. Repair of leaks may require the removal and replacement of manhole sections. The use of grout to repair leaks is not allowed.

Procedure:

- a. All lift holes shall be plugged.
- b. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them 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 recommendations.
- d. A vacuum of 10 in. of mercury shall be drawn on the manhole and then the vacuum line shall be throttled to maintain the 10 in vacuum for at least two (2) minutes. After the two minutes the valve on the vacuum line of the test head shall be closed, and the vacuum pump shut off. The time shall then be measured for the vacuum to drop to 9 in. of mercury.
- e. The manhole shall pass if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 9-3.
- f. Two (2) accurate vacuum pressure test gauges shall be installed to monitor the test.
Vacuum pressure gauges shall have graduation marks, at minimum, for every 0.2 in. of mercury and be capable of interpreting pressure readings within 0.1 in. of mercury. The pressure reading deviation between the two pressure gauges shall not be greater than 0.1 in. of mercury. During the vacuum pressure test the pressure loss indicated between the two gauges shall not deviate by more than 0.05 in. of mercury between the two gauges.

- g. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained. This does not mean that the Manhole Vacuum Test has to be repeated but rather a passing test has to be achieved by either the Manhole Vacuum Test or the Ex-filtration Test.

**TABLE 9-3
MINIMUM MANHOLE VACUUM TEST TIMES FOR
VARIOUS MANHOLE DIAMETERS PER DEPTH OF MANHOLE**

Manhole Depth (Feet)	48 in. Diam. MH (Seconds)	60 in. Diam. MH (Seconds)	72 in. Diam. MH (Seconds)
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121
>30	as per plans		

3. Ex-filtration Test: The Contractor shall furnish all necessary equipment and materials and shall be responsible for conducting, in the presence of the Engineer/Inspector, an ex-filtration test on each manhole. A separate manhole ex-filtration test will not be required when the manhole is tested simultaneously with the sewer pipe during an ex-filtration test.

It is not recommended to conduct the pipe leakage test concurrently with the manhole ex-filtration test, as the allowable parameters for head (H) in the two tests differ. However, a separate manhole ex-filtration test will not be required when manholes are tested simultaneously with the sewer pipe ex-filtration test. If the Contractor wishes to concurrently test the pipe and manhole then Table 9-2 may be used to assist in measuring the pipe loss for a concurrent test.

The manhole shall not allow ex-filtration of water of more than 0.10 gallons per hour per foot diameter per foot head (0.10 gal/hr/ft dia/ft head) with head being measured from the top of the water surface in the test manhole to

groundwater level outside the manhole or to the bottom of the manhole, whichever is less.

All pipes leading into or out of the manhole shall be plugged to provide a watertight seal and the manhole filled with water to a level three (3) to four (4) inches below the casting rim or lid. The water shall be allowed to stand for two (2) hours prior to beginning the test to allow for absorption into the manhole. If the water has dropped at the end of the two (2) hour stabilization period, additional water shall be added to bring the water level to at least three (3) to four (4) inches below the casting rim or lid, as initially was done. If the head is greater than 30 feet refer to the plan drawings for ex-filtration testing requirements.

The minimum test period shall be for two (2) hours and the values derived from Table 9-4 will need to be adjusted for the actual test time. If the test fails to meet these requirements, the Contractor shall, at his own expense, determine the source of leakage, repair or replace all deficiencies, and retest the installation until passing, all in a manner approved by the Engineer. This does not mean that the Ex-filtration test has to be repeated but rather a passing test has to be achieved by either the Ex-filtration Test or the Manhole Vacuum Test.

The Contractor shall anticipate the need to conduct multiple tests in order to meet the above requirements and shall conduct testing in such a manner and sequence that the requirements indicated above are achieved.

Water used for ex-filtration testing shall be clean, potable water and shall not be discharged into the sewer system. Such water shall be pumped from the manhole being tested and discharged at an approved discharge site.

**TABLE 9-4
MANHOLE EX-FILTRATION TEST - ALLOWABLE LEAKAGE**

Head (Feet)	<u>Allowable water drop in casting and cone per hour</u>					
	4 Foot Diam.		5 Foot Diam.		6 Foot Diam.	
	(gals)	(Inches)	(gals)	(Inches)	(gals)	(Inches)
2	0.8	0.32	1.0	0.40	1.2	0.48
4	1.6	0.64	2.0	0.80	2.4	0.96
6	2.4	0.96	3.0	1.21	3.6	1.45
8	3.2	1.29	4.0	1.61	4.8	1.93
10	4.0	1.61	5.0	2.01	6.0	2.42
12	4.8	1.93	6.0	2.42	7.2	2.90
14	5.6	2.25	7.0	2.82	8.4	3.38
16	6.4	2.58	8.0	3.22	9.6	3.87
18	7.2	2.90	9.0	3.63	10.8	4.35
20	8.0	3.22	10.0	4.03	12.0	4.84
22	8.8	3.55	11.0	4.43	13.2	5.32

24	9.6	3.87	12.0	4.84	14.4	5.81
26	10.4	4.19	13.0	5.24	15.6	6.29
28	11.2	4.51	14.0	5.64	16.8	6.77
30	12.0	4.84	15.0	6.05	18.0	7.26
>30	as per plans					

* Use of Table 9-4:

Example of a concurrent manhole and pipe ex-filtration test:

Given: 370 ft. of 10 in. sewer, groundwater approximately 2 ft. above the pipe invert at the manhole being tested, the manhole is 5 foot in diameter and the manhole is 17 ft. deep from rim to invert.

The calculated pipe loss for 370 ft. – 10 in. sewer would be (from Table 9-2) $0.09 \times 370 = 33.3$ gals in a 24-hour period. To adjust this loss to coincide with the manhole test the 33.3 gals would need to be converted, to two (2) hours; so $(33.3 / 24 \text{ hrs}) \times 2 \text{ hrs} = 2.78$ gals. The 2.78 gals is the permitted loss for the pipe in 2 hours.

The calculated manhole loss for a 5 foot diameter manhole 17 feet deep with groundwater 2 ft. above the invert would be (from Table 9-4) $17' - 2' = 15' \text{ H}$, round H down to 14 ft., the corresponding value from the 5 ft. Diam. Column results in a manhole loss of 7.0 gals. per hour. This value then needs to be converted to a two hour test. So $7.0 \text{ gals} \times 2 = 14 \text{ gals}$ for two hours.

The combined total loss would be 2.78 gals. (pipe) + 16 gals. (manhole) = 16.78 gals. This loss can be measured in inches of water surface drop in the cone by converting the gals in Table 9-4 to inches. The 7.0 gals. = 2.82 inches of drop, therefore 16 gals of loss equals $2 \times 2.82 \text{ inches} = 5.64 \text{ inches}$. The 2.78 gals. would be rounded down to 2.0 gals, which is equivalent to a 0.80 inch drop. Therefore the total water surface drop for a two hour test would be $5.64" + 0.80" = 6.44"$.

Another option instead of measuring the surface water drop would be to measure the volume of water required to bring the water surface back to the original level, at the start of the test. In order to achieve a passing test the volume of water needed to fill the cone would have to be less than 16.78 gals.

J. Abandoning Sanitary Sewer Mains and Manholes:

1. Existing Sewer Mains to be abandoned between manholes shall be plugged at all open ends with concrete extending into the abandoned pipe one foot or one pipe diameter, whichever is greater. Existing sewers to be abandoned at a manhole shall be cut flush with the inside of the manhole and plugged as specified above. The pipe shall be grouted flush with the inside of the manhole and the manhole invert shall then be reconstructed. The reconstructed manhole inverts shall provide for the new flow scheme and comply with the standards for manhole

inverts, as specified. The completed manhole shall be watertight and the inverts shall be smooth and uniform.

2. Existing Manholes to be abandoned shall have all pipes plugged with concrete extending into the abandoned pipe one foot or one pipe diameter, whichever is greater. The upper 4 ft. of the manhole shall be broken or removed and the manhole filled with compacted Select Granular Backfill material. The Contractor shall not backfill manholes to be abandoned until the Engineer/Inspector has inspected each plug.

Unless shown otherwise on the Drawings or specified in the Detailed Specifications, the Contractor shall salvage manhole frames and covers and deliver to and unload them at the City Utility Maintenance Shop on Steele Avenue.

K. Service Lines:

1. Permits, obtainable from the City Utility Maintenance Division, are required for all connections to the Rapid City sewer system. Applicants must hold a City Sewer & Water Installer Contractor's License. Refer to Section 11.
2. Horizontal distance between sewer service and water service lines shall not be less than ten (10) feet.
3. Service pipe shall be laid at a minimum slope of 1/8 inch per foot or as per plans. Minimum depth of cover over service lines shall be 3 1/2 feet.
4. Cleanouts shall be installed at all changes in horizontal alignment of greater than 45 degrees and at distances not to exceed 75 feet for four (4) inch diameter pipe and 100 feet for six (6) inch diameter pipe. Cleanout location and installation shall meet the more stringent of the above requirements of those of the adopted plumbing code.
5. Insulation for sewer services, when shown on the Drawings, shall be as specified for sewer mains.
6. Sewer Service New Connections: Where new service lines are to be installed for undeveloped property or future buildings, the Contractor shall furnish all materials necessary for connection of new service lines to the sewer main, except saddles which will be furnished and installed by the City, and shall obtain and pay permits and tapping fees as established by Ordinance. In-line tees may be used in lieu of saddles for 4 inch and 6 inch service lines. The use of an in-line service tee does not waive any tapping fees or the City inspection requirements. In-line tees shall be furnished and installed by the Contractor as the sewer main is installed.

New service connections and lines shall be, at a minimum, extended to the property line and the service line capped. The termination point shall be marked

with a minimum three (3) foot long steel fence post. The steel fence post shall be buried below the surface at least eight (8) inches and needs to be steel to facilitate location by magnetic locators.

City personnel shall tap all City sewer mains. The Contractor shall schedule all service taps between 7:30 AM to 3:00 PM, Monday through Friday.

7. Sewer Service Reconnections: The Contractor shall furnish all materials necessary for reconnecting service lines existing prior to reconstruction of a sewer main, except saddles, which will be furnished and installed by the City. On City projects all permits and tapping fees will be waived; however the Contractor shall obtain a no-charge "Right to Work" permit from the City Utility Maintenance Division.

In-line tees may be used in lieu of saddles for 4 inch and 6 inch service lines. The use of an in-line service tee does not waive any tapping fees or the City inspection requirements. In-line tees shall be furnished and installed by the Contractor as the sewer main is installed.

In-line tees may be used in lieu of saddles for 4 inch and 6 inch service lines. If a bid item is not provided for the in line sewer service tees, the Contractor with the Engineers approval, may substitute in-line service tees for saddles. The substitution of tees for saddles is a "no-cost" substitution and does not waive any tapping fees or the City inspection requirements. If a bid item for in-line sewer service tees is provided, the Contractor shall use the tees in place of saddles and the payment will be made at the unit price bid for in-line sewer service tees furnished and installed, including all labor and material.

On non-city projects the new account set-up / inspection permit (tap permit) will be waived, however the Right-to-Work permit and tapping fees are still applicable.

The Contractor shall visually inspect the inside of each existing sewer service line to be connected to the new sewer main prior to making the reconnection. When it is discovered that an existing sewer service line beyond the edge of the excavation is not in good physical condition or is plugged, full of roots, or is otherwise not operating properly, the Contractor shall notify the Engineer so he may document the condition and notify the property owner.

Connections between the new service line and existing service line shall be accomplished with a Fernco-type coupling. The Contractor shall encase the Fernco connection in six (6) inches of concrete six (6) inches each side of the coupling.

City personnel shall tap all City sewer mains. The Contractor shall schedule all service taps between 7:30 AM to 3:00 PM, Monday through Friday.

8. Abandoning of service lines shall be accomplished by cutting and plugging the line at the sewer main unless directed otherwise by the Engineer. The service line shall be plugged in the same manner as specified for plugging sewer mains.
9. Inspection: All sewer service installations and abandonment's shall be inspected by the City Utility Maintenance Division, prior to backfilling. The Contractor shall notify the City Utility Maintenance Division a minimum of four (4) hours prior to the time he wants the inspection. Any trench backfilled without being inspected and approved by authorized City personnel shall be re-excavated by the Contractor to expose the work for the required inspection. Discrepancies shall be corrected by the Contractor and re-inspected by City personnel.
10. Tracer Wire: Tracer wire shall be installed along with all sewer lines as described below:

The tracer wire shall be extended with the service line. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be brought to the surface at each clean out and shall terminate at the service connection point on the main.

At locations where the service line is not being replaced entirely, the Contractor will splice the new tracer wire to the existing tracer wire at the point of reconnection. In instances where a service line is not being replaced entirely and the existing tracer wire is not encountered, the Contractor shall coil approximately five feet of wire at the reconnection location(s) to facilitate a future splice.

All tracer wire connections shall be accomplished with "pig-tails." All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connections by using an appropriately sized wire nut, and preserving the splice or "pig-tail" by using a direct bury splice kit.

9.4 METHOD OF MEASUREMENT

- A. Sewer Main Pipe: Installed pipe quantities shall be measured from centerline to centerline of all manholes and special items to the nearest even foot. Depth of pipe shall be determined from top of finish grade to flow line of pipe. Standard depth is 0-6 feet and extra depth, if so bid, shall be in increments of two (2) feet.
- B. Sewer Service Pipe: Installed pipe quantities shall be measured from edge of sewer main pipe to fittings or end of pipe to the nearest even foot.
- C. Standard Manhole, Shallow Manhole, and Drop Manhole, 0-6 feet, shall be measured on a per each basis for the type and diameter of the particular manhole.

- D. Extra Manhole Depth per diameter of manhole being installed shall be measured to the nearest one tenth (0.1) foot from the top of finish grade to the invert of the manhole minus the nominal six (6) foot depth measured under Standard Manhole, Shallow Manhole, and Drop Manhole.
- E. Abandon Sewer Mains: No separate measurement will be made for plugging abandoned sewer mains; such work shall be incidental to the project, unless otherwise specified.
- F. Abandon Manhole: Measurement will be made on a per each basis for each manhole abandoned.
- G. Sewer Main Encasement: Measurement will be made on a per each basis for each encased crossing with lengths as noted on the Drawings.
- H. Insulation: Measurement will be made on a square foot basis to the nearest square foot.
- I. Sewer Service New Connections and Reconnections: Sewer service reconnections and sewer service new connections will be counted on a per each basis. Saddles will be furnished and installed by the City. The pipe used for connections and reconnections shall be measured and paid for under the bid item for sewer service pipe.
In-line tees may be used in lieu of saddles for 4 inch and 6 inch service lines. If a bid item is not provided for the in-line sewer service tees, then the Contractor, with the Engineer's approval may substitute in-line tees for saddles. The substitution of tees for saddles is a "no cost" substitution and does not waive any of the tapping fees or the City inspection requirements. If a bid item for in-line sewer service tees is provided, then the Contractor shall use the tees in place of saddles and the tees will be counted on a per each basis.
- J. Adjust Manhole Frame and Cover: Measurement will be made on a per each basis for each manhole frame and cover adjusted. The addition of or removal of cone or barrel sections required for adjustment will be measured and paid for as Reconstruct Manhole.
- K. Reconstruct Manhole: Measurement will be made on a per each basis for each manhole reconstructed. Reconstruct Manhole consists of the removal of or the addition of a new manhole barrel(s) or cone(s) for vertical adjustment. Adjustments of the frame and cover not associated with the addition of or removal of a barrel or cone shall be measured and paid for as Adjust Manhole Frame and Cover.
- L. Reshape Manhole Invert: Measurement will be made on a per each basis for each manhole that has the invert(s) reshaped and reconstructed.
- M. Sanitary Sewer Caps/Plugs: Measurement will be made on a per each basis for each cap/plug installed.

- N. Sanitary Sewer Cleanouts: Measurement will be made on a per each basis for each type and size of cleanout installed.
- O. Abandon Cleanout: Measurement will be made on a per each basis for each cleanout abandoned.
- P. Connection to Existing Manhole: Measurement will be made on a per each basis for each connection to an existing manhole.
- Q. Remove Manhole: Measurement will be made on a per each basis for each manhole removed.
- R. Remove Sewer Main: Measurement will be made on a linear foot basis and shall be measured to the nearest foot.
- S. Connection to Existing Sewer Main: Measurement will be made on a per each basis for each connection to an existing sewer main.
- T. In-line Sewer Service Tee: Measurement will be made on a per each basis for each in-line sewer service tee, except as covered under the provisions for "Sewer Service Connections and Reconnections."
- U. Tracer Wire: Tracer wire and all accessory items necessary for the installation of tracer wire shall be considered incidental to the sewer service pipe or force main installation.
- V. Sanitary Sewer Force Main, Fittings, Valves, and ancillary items: - Installed quantities shall be measured conforming with the applicable provisions of Section 8 Water Piping Systems, subsection 8.4 Method of Measurement.

9.5 BASIS OF PAYMENT

- A. Sewer Main Pipe: Payment will be at the unit price bid for the appropriate size and depth of sewer pipe, furnished and installed, including wastewater flow modifications, diversions, and/or pumping, trenching, excavation, Type 1 bedding material, compacting, backfilling, dewatering, sheeting or shoring, tracing wire, compaction, testing, and connections, if any, between the new main and existing main.
- B. Sewer Service Pipe: Payment will be made at the unit price bid for the appropriately sized pipe, furnished and installed, including trenching, excavation and backfilling, compacting, dewatering, tracing wire, and sheeting or shoring. The cost for any connections between the new service line and existing service lines shall be included in the unit price bid for the appropriate sized pipe.
- C. Standard Manhole and Standard Shallow Manhole: 0-6 feet, Payment will be made at the unit price bid for each type and diameter, furnished and installed including adjusting rings, frame and cover. Extra payment may be allowed for bolt-down

watertight frame and cover, if so specified as a bid item on the Bid Proposal. The extra payment will be the difference in cost between standard frame and cover and bolt-down frame and cover.

- D. Drop Manhole: 0-6 feet, Payment will be made at the unit price bid for each diameter, furnished and installed, with adjusting rings, frame and cover. Price bid shall include the wye and the pipe installed from the wye to the floor of the manhole. No separate payment will be made for this pipe, wye, and bend. Extra payment may be allowed for bolt-down watertight frame and cover, if so specified as a bid item on the Bid Proposal. The extra payment will be the difference in cost between standard frame and cover and bolt-down frame and cover.
- E. Extra Manhole Depth: Payment shall be made at the unit price bid for that depth, per the appropriate manhole diameter, over and above the six (6) foot, which is paid for as Standard Manhole, Shallow Manhole, and Drop Manhole.
- F. Abandon Sewer Mains: Payment for plugging abandoned sewer mains shall be incidental to the project, unless otherwise specified.
- G. Abandon Manhole: Payment will be at the bid unit price and shall include all labor, materials, including concrete plugs, and granular backfill.
- H. Sewer Main Encasement: Payment will be at the unit price bid, furnished and installed, including materials, temporary blocking and restraint of pipe, and incidental necessary to complete the work.
- I. Insulation: Payment will be at the unit price bid for insulation furnished and installed, including cushion material.
- J. Sewer Service New Connection: Payment will be made at the unit price bid for connecting new sewer services to the sewer main, including fittings necessary to connect the service line to sewer. Saddles will be furnished and installed by the City. Sewer service pipe will be paid for separately. Payment for Sewer Service New Connection shall include Right to Work permit, New Account Setup/Inspection permit (tap permit) and tapping fees, unless otherwise specified in the Detailed Specifications, including all labor and material.

In-line tees may be used in lieu of saddles for 4 inch and 6 inch service lines. If a bid item is not provided for the in line sewer service tees, the Contractor with the Engineers approval, may substitute in-line service tees for saddles. The substitution of tees for saddles is a "no-cost" substitution and does not waive any tapping fees or the City inspection requirements. If a bid item for in-line sewer service tees is provided, the Contractor shall use the tees in place of saddles and the payment will be made at the unit price bid for in-line sewer service tees furnished and installed, including all labor and material

- K. Sewer Service Reconnection: Payment will be made at the unit price bid for reconnecting existing sewer services to the sewer main, including fittings necessary

to connect the service line to sewer. Saddles will be furnished and installed by the City. Sewer service pipe will be paid for separately.

In-line tees may be used in lieu of saddles for 4 inch and 6 inch service lines. If a bid item is not provided for the in line sewer service tees, the Contractor with the Engineers approval, may substitute in-line service tees for saddles. The substitution of tees for saddles is a "no-cost" substitution and does not waive any tapping fees or the City inspection requirements. If a bid item for in-line sewer service tees is provided, the Contractor shall use the tees in place of saddles and the payment will be made at the unit price bid for in-line sewer service tees furnished and installed, including all labor and material

On City projects all permits and tapping fees will be waived. On non-City projects the New Account Setup/Inspection permit will be waived, however the Right-to-Work permit and tapping fees are still applicable.

- L. Adjust Manhole Frame and Cover: Payment will be at the unit price bid for adjusting manhole frame and cover including adjusting rings.
- M. Reconstruct Manhole: Payment will be made at the unit price bid for Reconstruct Manhole including new manhole barrel(s) and cones or removal of manhole barrel(s) and cone.
- N. Reshape Manhole Invert: Payment will be at the unit price bid for reshaping existing manhole inverts, including all materials, labor, equipment, wastewater flow diversions, modifications, and/or pumping.
- O. Sanitary Sewer Caps/Plugs: Payment will be at the unit price bid for Sanitary Sewer Cap/Plug furnished and installed, including all labor and materials.
- P. Sanitary Sewer Cleanouts: Payment will be at the unit price bid for Sanitary Sewer Cleanout furnished and installed, including all labor and materials.
- Q. Abandon Cleanout: Payment will be at the unit price bid and shall include all labor, materials, including concrete plugs, and backfill.
- R. Connection to Existing Manhole: Payment will be at the unit price bid and shall include all labor and materials.
- S. Remove Manhole: Payment will be at the unit price bid and shall include all labor, materials, including concrete plugs, and backfill.
- T. Remove Sewer Main: Payment will be at the unit price bid and shall include all labor, materials, including concrete plugs, and backfill.
- U. Connection to Existing Sewer Main: Payment will be at the unit price bid and shall include all labor and materials.

- V. In-line Sewer Service Tees: Payment will be Made at the unit price bid for “In-line Sewer Service Tee” furnished and installed, including all labor and material, except as covered under the provisions for “Sewer Service New Connections and Sewer Service Reconnections.”
- W. Tracer Wire: Tracer wire and all accessory items necessary for the installation of tracer wire shall be considered incidental to the sewer service pipe or force main installed.
- X. Sanitary Sewer Force Main, Fittings, Valves, and ancillary items: Payment will be In conformance with the applicable provisions of Section 8 Water Piping systems, Subsection 8.5 Basis of Payment.

END OF SECTION

SECTION 10

CLEARING AND GRUBBING

10.1 DESCRIPTION

A. General:

This work consists of clearing, grubbing, removing and disposing of vegetation and debris within the limits of the right-of-way, borrow and easement areas, except such objects designated to remain or to be removed in accordance with other sections of these specifications.

B. Related Work:

Section 7 - General Conditions
Section 17 - Salvaging, Stockpiling, and Placing Topsoil
Section 74 - Planting Trees, Shrubs, and Vines
Section 75 - Transplanting Trees and Shrubs
Section 201- Construction Stakes, Lines and Grades (Contractor Grade Staking)

10.2 MATERIALS (not specified)

10.3 CONSTRUCTION REQUIREMENTS

Unless otherwise provided for in the Bidders Proposal, under the bid item "Contractor Furnished Staking", the Engineer will establish right-of-way lines and construction lines and designate trees, shrubs, plants, and other objects to be removed. Vegetation and objects not marked for removal shall be preserved free from injury or defacement.

Surface objects, trees, stumps, roots, and other protruding obstructions designated for removal shall be cleared and/or grubbed as required. When authorized, the Contractor may leave stumps and nonperishable solid objects, which are located outside of the roadway and a minimum of three (3) feet below slope of embankments, provided they do not extend more than six (6) inches above the existing ground line or low water level.

Except in areas to be excavated, holes resulting from the removal of obstructions shall be backfilled with suitable material and compacted under the same specification as the embankment. All disturbed areas shall be permanently reclaimed.

Materials, debris, and perishables shall be disposed of at locations outside of the roadway and by methods approved by the Engineer. If disposal is by burial on the project, a cover material of at least twelve (12) inches shall be provided and the area shall be graded and shaped to the satisfaction of Engineer. If the disposal location is off the project, the Contractor shall make all arrangements with affected property owners in

writing for obtaining suitable disposal locations, which shall be outside the limits or view from the project. The cost involved shall be included in the unit price bid.

Timber which can be utilized for logs, posts, poles, ties, or cordwood, shall be considered as merchantable timber and shall be the property of the previous landowner unless otherwise specified.

Such timber shall, when so noted in the contract, be trimmed and cut into merchantable lengths and neatly piled adjacent to the right-of-way at locations designated by the Engineer. The Contractor will not be required to cut merchantable timber into lengths shorter than sixteen (16) feet.

Low-hanging, unsound, or unsightly branches on remaining trees or shrubs shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to provide adequate sight distance for vehicular or pedestrian traffic in accordance with City Ordinance and with good tree trimming practices.

All activities associated with this contract shall conform to the City of Rapid City Municipal Code Chapters 8.34 through 8.44 and Pennington County Ordinance #12, regarding air quality compliance.

10.4 METHOD OF MEASUREMENT

Measurement for clearing and grubbing trees and stumps over six (6) inches in diameter will be on a per each basis by actual count of such trees and stumps which are satisfactorily removed and disposed of. The diameter of trees and stumps will be measured two (2) feet above the ground. Old stumps extending less than two (2) feet above ground will not be counted. No more than one (1) tree will be counted from any one (1) stump.

Field measurement for the item of "Clearing" will not be made.

10.5 BASIS OF PAYMENT

The removal of trees and stumps over six (6) inches in diameter will be paid for at the contract price per each for the items "Clear and Grub Trees" and "Clear and Grub Stumps", respectively. When these items are not included in the contract, the removal of trees and stumps will be incidental to the lump sum payment for the item of "Clearing".

The lump sum payment for "Clearing" will be full compensation for the removal and disposal of vegetation and debris, except as provided above for trees and stumps over six (6) inches in diameter.

END OF SECTION

SECTION 11

UTILITY EXCAVATION AND BACKFILL

11.1 DESCRIPTION

A. General:

This work consists of excavation, backfill and compaction of trenches for installation of underground utilities, which includes Private Utility Installations, Water Piping Systems, Sanitary Sewers, and Storm Sewers and Pipe Culverts. This includes, but is not limited to, dewatering, rock and/or muck excavation and disposal, bedding, and shoring and bracing.

B. Related Work:

Section 7	General Conditions
Section 8	Water Piping Systems
Section 9	Sanitary Sewer
Section 10	Clearing and Grubbing
Section 13	Removal Items
Section 14	Embankment
Section 15	Disposal of Surplus Excavation and Waste
Section 17	Salvaging, Stockpiling, and Placing Topsoil
Section 18	Erosion and Water Pollution Control
Section 19	Incidental Work
Section 41	Utility Trench Resurfacing
Section 54	Pipe Culverts
Section 90	Traffic Control
Section 112	Select Granular Backfill
Section 120	Reinforced Concrete Pipe
Section 121	Corrugated Metal Pipe
Section 117	Aggregates for Granular Bases and Surfacing
Section 200	Controlled Low Strength Material

C. License and Permit Requirements

1. Any person or Contractor engaging in the business of excavating in the public right-of-way (ROW) shall comply with the provisions of the Rapid City Municipal Code, Chapter 13.10, "Trenching Contractor's Licenses". The Contractor shall refer to Chapter 13.10 for the actual definition of work covered under the code.
2. Any person or Contractor engaging in the business of excavating in the public ROW for such purposes of constructing, altering, repairing or improving water and sewer mains; appurtenances and/or service lines and storm sewers shall comply with the provisions of the Rapid City Municipal Code, Chapter 13.10,

- “Trenching Contractor’s Licenses”. The Contractor shall refer to Chapter 13.10 for the actual definition of work covered under the code.
3. Dirt/dust control shall be as specified in Section 7.28.
 4. City of Rapid City, South Dakota Department of Transportation (SDDOT) and Railroad Right-to-Work Permits are required from the same when working within their ROW.
 5. A Right to Work permit, if applicable, is required from the City of Rapid City Utility Maintenance Group (Utility Maintenance).
 6. Tapping fees for the taps themselves shall be paid for at the time the Right to Work permit is obtained from Utility Maintenance.
 7. New Account Set-up inspection permits (tapping permits), if applicable, are required from Utility Maintenance.
 8. Blasting and the use of explosives
 - a. The Contractor shall comply with all Federal Regulations and OSHA provisions.
 - b. The Contractor shall comply with Section 7.43 – General Conditions, “Use of Explosives”.
 - c. A permit for use of explosives shall be obtained from the Rapid City Fire Department.

D. Submittals/Test Samples

1. Soil tests

The Contractor shall provide the Engineer with the results of a modified proctor soil compaction test, as determined by the AASHTO T180 test, for those locations and depths determined by the Engineer. When requested, the Contractor shall provide the Engineer with no less than 25 pounds of each sample appropriately labeled with the project title, the location from which the sample was obtained and the date of sample collection. A City Construction Observer shall be present during sample collection. Soil samples shall be submitted to a certified soils testing lab within 24 hours of the Engineer’s request. Failure to do so will cause the City to submit the samples and charge the Contractor at one and a half (1½) times the cost incurred. Results shall be delivered to the City directly from the testing Laboratory.

2. The Contractor shall submit to the Engineer a Traffic Control Plan for the proposed construction activity unless waived by the Engineer. The Traffic Control Plan shall conform to Standard Specifications.

3. The Contractor shall provide a submittal to the Engineer for the materials proposed for use under Section 112 - Select Granular Backfill unless waived by the Engineer.
4. The Contractor shall provide a submittal to the Engineer for the materials proposed for use under Section 200 - Controlled Low Strength Material unless waived by the Engineer.

11.2 MATERIALS

- A. Select granular backfill and bedding shall be in accordance with Section 112 - Select Granular Backfill.
- B. Controlled low strength material used for bedding or backfill shall be in accordance with Section 200 - Controlled Low Strength Material.

11.3 CONSTRUCTION REQUIREMENTS

- A. The Contractor shall contact SD One Call for the locations of public and private utilities prior to any excavation. Underground utilities shown on the plans are not necessarily exact and, therefore, must be located by the individual utility company prior to excavation activities. The Contractor shall attempt to contact the local residents/owners whenever any excavation may affect their property.
- B. Trenching
 1. Methods

Under ordinary conditions and where the depth of excavation and soil conditions will allow, excavation shall be by open cut from the surface. Tunneling or boring may be required under sidewalks, curb and gutter, or other surface structures. However, no additional compensation will be allowed for such tunneling or boring.

Where surface conditions allow, the Contractor will be permitted to slope or bench the trench sidewalls from a point three inches above the top of the pipe barrel. Below this point, the trench walls shall be vertical. Contractor shall shore as necessary. This requirement does not relieve the Contractor of the responsibility of meeting all applicable OSHA requirements.

Excavated material suitable for backfill shall be deposited sufficiently distant along the sides of the trench to limit the potential for cave-in and shall be so deposited that the public shall be inconvenienced as little as possible.

All excavated material not required for backfill shall be removed from the project by and at the expense of the Contractor as directed by the Engineer.

All rock, including excavated bedrock and large loose rock such as boulders or fieldstone, muck or other unsuitable material, which cannot be used as backfill, shall be segregated from the rest of the excavated material and removed from the project by and at the expense of the Contractor. Unsuitable material, which cannot be used for backfill, shall be determined by the Engineer. Established drainage in the street, alley, or drainage ditch, must be maintained by the Contractor during his construction operations to limit further damage and unnecessary removals.

Streets that utilize an engineering fabric underlayment shall be excavated down to the underlayment by hand, or other method that will prevent damage to the fabric. The first pavement saw cuts shall be a minimum width of six feet centered over the utility (see Standard Detail). Care shall be taken to leave the fabric undamaged. The fabric shall be slit lengthwise centered over the utility, the fabric laid back, and the trench excavated and backfilled in normal fashion. When the backfill is completed to the elevation of the original fabric, the slit fabric ends shall be placed back on the backfilled material; a minimum six foot wide piece of similar material shall be placed centered over the top of the existing slit fabric; and a minimum geogrid/fabric overlap of three feet shall be maintained. The geogrid/fabric repair shall be inspected by the Engineer prior to placing base course or cushion. After inspection of the geogrid/fabric, it may be covered with base course to the existing paving base grade. The base course can then be compacted and readied for pavement. Just prior to pavement replacement, a second saw cut shall be completed at a minimum of 12 inches away from the first saw cut (see Standard Detail).

Where the proposed trench intersects a sub drain or an edge drain, the sub or edge drain shall be repaired with a like drain material to a width one foot on either side of the trench width. The joints shall utilize a factory repair joint or shall be properly overlapped, wrapped with fabric and repair tape. New clean rock drainage material shall be placed across the trench intersection and backfilled with appropriate material outside of the sub or edge drain limits. The drain repair shall be inspected by the Engineer prior to placing the clean rock.

When either engineering fabric or sub or edge drains are inadvertently encountered and damaged, the Contractor is responsible to notify the Engineer as soon as practical. No further excavation or repairs of the area shall be effected without the knowledge of the Engineer.

Damage to the property of others, such as engineering fabric, edge or sub drains, private or public utilities, fences, trees, shrubs, lawns, sidewalks, etc. shall be repaired or replaced the Contractor's expense unless removal of such is shown on the plans or written permission was first obtained from the Engineer.

2. Protection of the excavation

The Contractor shall be solely responsible for providing a safe trenching operation and shall, as a minimum, comply with all OSHA regulations, regardless of limits of trench width imposed by project plans work limits, site constraints or the direction of the Engineer.

The Contractor shall employ qualified, properly trained personnel to design, place and maintain shoring during progress of work until the trench is backfilled.

Failure to properly shore and/or brace excavations shall be at the risk of the Contractor and any damage to pipes, curb and gutter, street pavement, grassed areas, storm sewer and appurtenances, gas mains, and/or other public or private property occurring through settlements, heaving, water or earth pressures, slides, caving, or other causes due to failure of shoring, improper shoring, or lack of shoring, or due to negligence on the part of the Contractor, shall be repaired by the Contractor at his own expense and to the satisfaction of the Engineer.

When utilized, the shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has progressed far enough to provide adequate strength. Unless left in place by written order of the Engineer, shoring shall be removed as work progresses. Shoring devices and methods of construction utilizing shoring devices are the sole responsibility of the Contractor.

3. Dewatering

The Contractor shall be responsible for evaluating soil and groundwater conditions and for furnishing and maintaining necessary and suitable dewatering devices and equipment.

The Contractor shall provide for positive drainage away from the excavation or otherwise take steps to protect the excavation and backfill from becoming excessively wet prior to placing the finished surface.

If the Engineer determines that any portion of the backfill or trench has become excessively wet during excavation and/or backfill operations, the Contractor shall, at his own expense, remove the material to the satisfaction of the Engineer and furnish an approved backfill and/or bedding material that meets specifications.

At all times, the Contractor shall provide and maintain ample means and devices, with which to remove promptly and properly dispose of all water that enters the excavation.

The Contractor shall dispose of water in a suitable manner without damage to adjacent property or without creating a health hazard or nuisance condition. Water may not be discharged to private property or to irrigation ditches without prior approval from the affected property owner or ditch company. No water shall be drained into work built or under construction without prior consent of the Engineer.

Dewatering shall be accomplished by placing well points, sumps or any other acceptable method, which will insure a dewatered trench. Any proposed dewatering method shall be subject to the approval of the Engineer. The Contractor will not be permitted to allow groundwater to drain through completed sewers. The Contractor will be required to thoroughly clean all debris and sediment from newly installed sewers as directed by the Engineer.

The Contractor shall provide for positive drainage of water away from the excavation and take the necessary action to protect the excavation and backfill from becoming excessively wet prior to placing the finished surface. If the Engineer determines that any portion of the backfill or trench has become excessively wet due to actions or inactions of the Contractor after the initial excavation, the Contractor shall remove the soil and/or pipe or appurtenance(s) to the satisfaction of the Engineer and furnish an approved backfill material that meets specifications and reinstall the pipe and/or appurtenance(s) as specified herein, all at no expense to the City.

4. Trench Dimensions

The following table shall be used to determine the acceptable minimum trench widths for the City. The table in general is a compilation of AWWA criteria and Uni-Bell criteria. The criteria used in compiling this table are presented in Paragraphs a. and b. For purposes of establishing acceptable minimum trench widths, the dimensions in the table shall govern unless specifically indicated otherwise on the drawings.

TABLE 11-1

MINIMUM TRENCH WIDTH TABLE

<u>Pipe Diameter</u>	<u>Minimum Width</u>
<8 in	24 in
8 in -12 in	30 in
14 in –18 in	36 in
20 in -21 in	42 in
24 in –36 in	1.25(Pipe OD) plus 12 in
>36 in	Per plans

The Contractor shall adhere as closely as possible to the minimum trench widths.

The Contractor will not be allowed to excavate excessive trench width in lieu of adequate dewatering or shoring.

- a. Pressure Pipe Installation (Water and Force Main)
For reference, only Table 11-1 will be enforced.

Minimum Trench Width: The minimum clear trench width measured at a point three inches above the top of the pipe barrel shall not be less than 18 inches or the outside pipe diameter, plus 12 inches, whichever is greater or such width as approved by the Engineer.

b. Non-Pressure Pipe Installation (Gravity Sewer Main)

For reference, only Table 11-1 will be enforced.

1) Minimum Trench Width: The minimum clear trench width measured at a point three (3) inches above the top of the pipe barrel shall not be less than the greater of:

- a) Minimum of eighteen (18) inches, or
- b) The outside pipe diameter, plus sixteen (16) inches, or
- c) The outside pipe diameter multiplied by 1.25, plus (12) inches, or
- d) Such width as approved by the Engineer.

c. Maximum Trench Length: Not more than 300 linear feet of trench shall be open at any one time in the public Right-of-Way, in easements that contain City owned utilities, or near roadways..

5. Foundations: Foundations shall be considered as that material which is neither bedding nor backfill, but is used under the pipe or conduit for support in the bottom of the trench.

a. Normal Trench Bottom: The bottom of the normal trench where the undisturbed soil is of a supportive nature for the pipe or conduit laid, as determined by the Engineer, shall be accurate for line and grade to provide uniform bearing and support for each section of pipe or conduit. Bell holes and depressions for joints shall be dug after the trench bottom is graded, and shall be no greater in length, depth, and width than required for making the joint. The undisturbed trench bottom shall be at least 3 inches below the pipe invert, to allow for the placement of Type 1 Bedding material.

b. Rock Trench Bottom: When solid rock, large loose rock, such as field stone, very coarse gravel, or any other material of a similar nature that is stable but will not allow a proper foundation for the pipe or conduit, is encountered at the trench bottom, it shall be excavated to a sufficient depth to allow refilling under the body and joints of pipe or conduit. The undisturbed trench bottom shall be at least 3 inches below the pipe invert, to allow for the placement of Type 1 Bedding material.

c. Unstable Trench Bottom: When the trench bottom is earth that will not support the pipe or conduit, the earth shall be considered an unstable foundation and shall be excavated below grade as directed by the Engineer. A solid foundation shall be built with select granular backfill material or with controlled low strength material.

The amount and type of foundation material required will vary depending upon the soil encountered. Generally, foundation material shall be Type 1 Bedding Material or Type 2 Foundation Material, per Section 112 or Controlled Low Strength Material per Section 200.

In some circumstances, larger foundation material may be necessary and in these cases Type 3 or 4 Foundation Material or Stabilization Rock maybe used per Section 112. If Type 3 or 4 Foundation Material or Stabilization Rock is used, then a minimum 6 inches of Type 2 Foundation Material shall be placed directly above the material and prior to the placement of the Type 1 Bedding Material. This helps to minimize the potential for the Type 1 Bedding material to migrate into the larger foundation material and result in loss of pipe support. The Engineer shall determine the use of Controlled Low Strength Material or Foundation materials, in cases of unstable trench bottom.

Foundation material shall be compacted and placed in separate lifts from the trench bottom up to three inches below the pipe invert. Foundation material lifts shall not exceed eight inches and each lift shall be compacted separately.

6. Rock Excavation: Rock excavation shall include solid rock in ledges, bedded deposits, un-stratified masses and conglomerate deposits so firmly cemented as to present the characteristics of solid rock, which must be removed by drilling, blasting, jack hammering, hydraulic ripper, or similar methods. Shale, regardless of the nature of deposit, or loose boulders or large fieldstone will not be considered rock excavation unless so designated on the plans. The responsibility and cost of satisfactorily demonstrating to the Engineer that the material being considered for rock excavation cannot be removed by means other than drilling, blasting, jack hammering, hydraulic ripper, or similar methods shall be the obligation of the Contractor.

At a minimum, it shall be demonstrated that a normal excavating machine being skillfully operated cannot effectively remove said material. "Effectively removed" shall be defined as, the normal production rate being reduced to 25% of normal. A normal excavating machine will be considered to be a +230 HP hydraulic excavator, crawler weighing +78,000 pounds with a – 1 CY bucket equipped with rock or ripper teeth.

The Contractor shall dispose of all unsuitable excavated material. The Contractor shall provide a disposal site for unsuitable backfill materials. The disposal site shall be approved by the Engineer.

The Contractor shall furnish an approved backfill material to fill the void left by rock excavation. He shall also provide the results of a modified proctor (AASHTO T-180) test for the furnished backfill.

The Contractor shall keep accurate daily records of the quantity of rock removed so a comparison can be made with the Inspector's records. The Contractor shall

deliver his records of Rock Excavation to the Engineer or his representative within 48 hours. Records of Rock Excavation delivered after this period shall be declared invalid and no payment for Rock Excavation will be made.

7. Blasting and the Use of Explosives

All materials removed by blasting which cannot be shoveled as earth shall be deemed unsuitable and shall be handled and disposed of separately from other suitable backfill materials as directed by the Engineer. The Contractor shall provide a disposal site for unsuitable backfill materials. The disposal site shall be approved by the Engineer.

Where blasting is necessary, the Contractor shall comply with the laws, ordinances, and applicable safety code requirements relative to the handling, storage and use of explosives and the protection of life and property. Suitable covering or shielding shall be provided to confine all materials lifted by blasting, within the limits of the trench of excavation, and prevent injury to property or life. The Contractor shall be responsible for all damages caused by his blasting operations. The Contractor will demonstrate that he is in compliance with applicable laws, rules, and regulations, and that he has the required expertise in advance of any blasting work. The Contractor shall notify all governmental agencies, property owners and utility owners that may be affected by the blast 48 hours in advance.

The Contractor shall receive "approval", in writing, for any proposed blasting in the public Right of Way, an easement, or that is within 100 feet of an underground public utility. The Contractor shall refer to the sub-section titled "Use of Explosives" in Section 7 - General Conditions, for additional requirements when blasting. The Contractor shall request the "approval" at least 48 hours prior to blasting. The Contractor shall be responsible for any safeguards or monitoring required by the Engineer for the blasting operations and shall be responsible for any and all damages resulting from the blasting operations.

8. Unsuitable Backfill Material Excavation: Unsuitable Backfill Material Excavation shall consist of the removal and disposal of unsuitable material, which in the opinion of the Engineer is not suitable as backfill material. The Contractor shall provide an approved disposal site for unsuitable material. The Contractor shall provide and use any necessary shoring devices necessary to maintain trench walls.

The shortage of backfill material created by the removal of the unsuitable material shall be replaced by the Contractor with an approved imported backfill material meeting specifications. Payment for imported backfill will be considered if the Contractor has not wasted suitable material from the project. The Contractor shall provide the results of a modified proctor analysis (AASHTO T-180) for all furnished imported backfill material, except Controlled Low Strength Material.

C. Pipe Bedding

Water and Sewer pipe, appurtenances, and service lines shall be installed as per Sections 8 and 9 and as described below:

1. All water and sanitary sewer pipe, appurtenances, and service lines; except copper water services shall be bedded with Type 1 Bedding material from 3 inches below the pipe invert to 3 inches above the pipe crown over the full width of the trench. Type 1 Bedding Material shall meet the requirements of Section 112.

Copper water services shall be bedded from three inches below the pipe invert to three inches above the pipe crown over the full width of the trench. The bedding shall be Type 1 Bedding Material, or in lieu of Type 1 Bedding Material, washed sand or crusher fines may be used.

- a. Type 1 Bedding shall be compacted and placed as a separate lift from the trench bottom, or top of Foundation material, to the pipe invert and shall be placed and compacted prior to the pipe or appurtenance being placed in the trench.
 - b. Type 1 Bedding shall be hand tamped and placed as a separate lift from the pipe invert to the pipe spring line. The Type 1 Bedding shall be placed in lifts and the maximum lift shall not exceed 6 inches.
 - c. Type 1 Bedding shall be hand tamped and placed as a separate lift from the pipe spring line to 3 inches above the pipe crown. The Type 1 Bedding shall be placed in lifts and the maximum lift shall not exceed 6 inches.
 - d. Type 1 bedding material shall be incidental to water and sewer pipe per sections 8 and 9. Prior to commencing installation of water and sewer pipes, the Contractor and Engineer shall determine the rates of material to be used for each diameter of pipe being installed, in conjunction with the Contractor's proposed excavator bucket width (maximum trench width). These rates of material use shall be used as a method of quantifying the minimum amount of bedding material required for the project. The Contractor and Engineer shall, on a daily basis, quantify the amount of Type 1 bedding material installed, along with the corresponding quantity of water and sewer pipe. The Contractor shall submit weigh tickets for Type 1 bedding material to the Engineer daily. The weigh tickets shall clearly state, "Type 1 bedding material, incidental." All stockpiled bedding material used for water and sewer pipe installation shall be clearly identified on the project.
2. Bedding material from 3 inches above the pipe crown to 12 inches above the pipe crown shall be Select Bedding Material. Select Bedding Material may include loam, clay, sand, and gravel, but shall be free of cinder, ashes, refuse, organic matter, rock or material determined unsuitable by the Engineer. No

material larger than one (1) inch in size shall be permitted. Frozen material shall not be used.

Select Bedding Material maybe native excavated material or material brought from offsite. Select Bedding Material shall be hand-tamped in the trench for its full width on each side of the pipe, simultaneously. Mechanical tampers may be used if pipe damage will not occur.

3. Controlled Low Strength Material maybe used in lieu of Type 1 Bedding or Select Bedding Material as approved by the Engineer or as required on the drawings or specifications. Controlled Low Strength Material shall be installed in accordance with Section 200.
4. Check Dam Installation – Check dam installation shall be as indicated on the drawings or in the detailed specifications. However, at a minimum, check dams shall be installed every 450 feet of water and sewer main installed, at all laterals (tees and crosses), and at service lines, where they connect to the main.

The check dams shall extend vertically from the bottom of the excavation through the bedding material to the “normal backfill” zone and shall extend horizontally from trench sidewall to trench sidewall. The check dam shall seal the bedding material to prevent ground water movement in the bedding material along the trench. Check dam material shall be on site cohesive material compacted to the density of surrounding soil of the trench. Check dam installation and material shall be considered to be incidental to the installation of the main or service.

- D. Backfilling and Compaction - Backfill shall start one (1) foot above the pipe or conduit crown and continue to the surface of the trench. The Contractor shall take precautions to backfill trenches in a manner that installed pipe or conduit will not be disturbed.

All backfill material shall be free from cinders, ashes, refuse, vegetable or organic material, boulders, rocks, or stones, or other material, which the Engineer determines to be unsuitable. From one foot above the pipe or conduit crown to two feet above the pipe or conduit crown, the maximum stone size shall be limited to three inches in diameter. From two feet above the top of the pipe, stones up to twelve inches along their longest dimension may be included in the backfill, unless otherwise specified.

When the type of backfill material is not specified, the Contractor may backfill with the excavated material provided that the Engineer determines that it is suitable. Where excavated material is deemed unsuitable, or where there is a shortage of backfill material, the Contractor shall furnish an approved Imported Backfill unless otherwise specified. Controlled Low Strength Material will be considered acceptable as backfill material when installed in accordance with Section 200 or as directed by the Engineer.

Should the Contractor cause the trench to be excavated to a greater depth or width than that designated of the drawings, herein, or as directed by the Engineer, the Contractor shall refill to grade, at his own expense, with an approved material, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable material with which to form a solid bed for the pipe.

Frozen material shall not be permitted as trench backfill.

Prior to backfilling, the Contractor shall not sell, remove, or permit to be removed, suitable backfill material required to complete the project, provided a designated stockpile location is provided. If suitable backfill material is removed, the Contractor shall document the quantity of material removed and provide this information to the Engineer within 24 hours of its removal.

E. Embankment

Where embankment is necessary to support pipe or to cover or protect it in any way, it shall be placed to the dimensions shown on the plans or as directed by the Engineer. The surface of the ground receiving the embankment shall be cleared of all unsuitable material and scarified, or loosened with a disc or multi-toothed hydraulic ripper; moisture adjusted and re-compacted as directed by the Engineer. Embankment shall then be formed of an approved material and compacted to the densities specified herein unless otherwise specified. Embankment shall be placed prior to laying pipe. Unless otherwise approved, pipe laid in embankment shall be trenched in.

F. Compaction

The Contractor shall compact all backfill to the following densities, unless modified by the Detailed Specifications or by the direction of the Engineer:

<u>SOIL TYPE</u>	<u>BACKFILL MOISTURE CONTENT</u>	<u>% OF MAXIMUM DRY DENSITY</u>
Cohesive	3% Below to 8% Above Optimum	92% Minimum
Non-cohesive	Workable	95% Minimum

Maximum dry density and optimum moisture content shall be determined by the AASHTO T-180, Modified Proctor Test.

Backfill moisture and density shall be determined at least every 200 feet horizontally and every three (3) feet vertically in pipe line trenches. However, the Engineer may take moisture and density tests at any location and depth he desires. The Contractor shall, at his own expense, excavate the backfill at those locations and to those depths required by the Engineer to conduct moisture/density tests.

When specified moisture contents are not met, the Contractor has the options of drying wet soil, furnishing approved materials meeting specifications, or adding water as necessary, to soils that are too dry to meet specifications. If water is added to dry soil, it must be thoroughly mixed with the soil to provide uniform moisture content prior to backfilling.

Backfill material not meeting specified densities shall receive additional compaction or shall be removed and replaced at the Contractor's expense as necessary to meet specified densities. Wet soils that otherwise meet the requirements for backfill do not necessarily constitute unsuitable material. It is the contractor's responsibility to either dry the material or furnish other approved material at his expense, unless otherwise specified herein. When the Contractor furnishes backfill material, he shall also furnish the results of the AASHTO T-180 test for the furnished material.

Controlled Low Strength Material installed in accordance with Section 200 or as directed by the Engineer will not require compaction testing.

The Contractor shall not place the finished surface (asphalt, curb and gutter, grass, etc.) until the specified densities are met at each test location and the Engineer gives his approval for placement.

Trench flooding, with water, as a method of compaction is prohibited.

G. Frost

When frost in the ground becomes deep enough to inhibit excavation, the Contractor may request a stop work order. However, it shall be the Contractor's responsibility to prove to the Engineer that the cost of excavation due to the frost is excessive and a stop work order is justified. The request for the stop work order shall be made in writing. Regardless of when the request is made, contract time will not stop until the stop work order is issued, i.e. the order will not be retroactive. Stop work orders shall be made in accordance with Section 7 unless otherwise modified herein.

As a prerequisite to issuance of the stop work order, the Contractor shall backfill and compact all open excavations and clean up the project to the satisfaction of the Engineer.

The Engineer may issue a Notice to Proceed when conditions improve to the point where frost does not inhibit excavation and a resumption of work is possible. The resumption of work and Notice to Proceed shall be made in accordance with Section 7 unless otherwise modified herein.

H. Cleanup

Trenches located in public right-of-way shall be backfilled, compacted, and restored to original condition as soon as practicable. In cases where the permanent surfacing will not be placed within 24 hours of backfill, the Engineer may require temporary surfacing. Temporary surfacing shall be considered as incidental to the bid item for

the pipe or conduit for which it pertains unless a bid item is specifically provided for Temporary Surfacing.

Temporary Surfacing shall consist of materials as specified in Section 112, Section 117, or asphalt millings.

I. Bedding Boxes and other similar devices

If bedding material is a unit price pay item the contractor shall use a bedding box or other similar device for the storage of Type 1 Bedding Material and Select Granular Backfill Materials. The bedding box shall follow the progression of work and shall be used to store the materials prior to their placement in the trench. The use of such devices will minimize contamination and waste of the material. The Engineer may make a deduction in the quantity, for payment purposes, of Type 1 Bedding Material and/or Select Granular Backfill Material if the material is being contaminated or wasted.

J. Underground Obstructions

The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies and the City, but this does not relieve the Contractor of the responsibility of determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables or structures that will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the owners of the structure involved and the Engineer. When necessary, the Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.

Portions of existing utilities, which are found to interfere with the line and / or grade of the proposed utility, will be relocated, altered or reconstructed by the utility companies, or the Engineer may order changes in the work to avoid interference. Such changes will be considered to be extra work and will be paid for through a change order. When the plans or specifications provide for the Contractor to alter, relocate, or reconstruct an existing utility, all costs for such work shall be included in the bid for the items of work necessitating such work unless a separate bid item is provided. Temporary or permanent relocation or alteration of existing utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where existing utility relocation or reconstruction is impractical, the Engineer may order a deviation from line and grade.

The Contractor shall be responsible for notifying the various utility companies if the Contractor's work will expose, affect or endanger any existing utility. All cost of investigation and any necessary protection, support, removal or relocation of said structures shall be included in the contract bid price for installing pipe manholes, etc. The Contractor shall not begin construction until all utility companies have been contacted and their respective underground utilities have been located and marked.

All costs for exploratory investigation/excavation necessary for determining the location and depth of utilities shall be included in the contract bid price for installing the proposed utility.

11.4 METHOD OF MEASUREMENT

A. Protection of the Excavation

No measurement will be made, as these items are considered to be incidental to utility being installed, unless specifically indicated otherwise.

B. Dewatering

No measurement will be made, as this item is considered to be incidental to utility being installed, unless specifically indicated otherwise.

C. Rock Excavation

Measurement will be based on the measured and/or calculated volume of the open trench to the nearest whole cubic yard and will be limited to a maximum trench width of six (6) feet. At Manholes the allowable trench width for computation will be increased from 6 ft. to 10 ft. wide for a distance 7 ft. each side of the manhole center.

D. Select Granular Backfill Materials

Measurement for Select Granular Backfill materials will be in accordance with Section 112 except as further defined below.

Type 1 bedding material for water and sewer pipe installations described in specification sections 8 and 9 shall be considered to be incidental to the pipe being installed. The Contractor and Engineer shall, on a daily basis, quantify the amount of Type 1 bedding material installed, along with the corresponding quantity of water and sewer pipe. The Contractor shall submit weigh ticket for the Type 1 bedding material daily to the Engineer. The weigh tickets shall clearly state, "Type 1 bedding material, incidental." All stockpiled bedding material to be used for water and sewer pipe installation on the project shall be clearly identified.

Type 1 bedding material used as foundation material or for uses other than water and sewer pipe installation shall be measured in accordance with section 112..

E. Imported Backfill

When unsuitable material is encountered during trench excavation, the unsuitable material shall be removed and disposed as previously specified. If the unsuitable material removal and disposal creates a shortage of material, and the Contractor has not wasted suitable material from the project, Imported Backfill will be used to eliminate the shortage of available suitable backfill material. Measurement of the Imported Backfill,

unless otherwise stated in the Detailed Specifications will be to the nearest compacted cubic yard as placed in the trench. If suitable material was wasted from the project prior to encountering unsuitable material, measurement and payment for Imported Backfill will not be considered provided a designated stockpile location was identified.

F. AASHTO T-180 Soil Test

This item will be measured per each as submitted to a certified lab and approved by the Engineer.

11.5 BASIS OF PAYMENT

A. Protection of the Excavation

No payment will be made, as these items are considered to be incidental to utility being installed, unless specifically indicated otherwise.

B. Dewatering

No payment will be made, as this item is considered to be incidental to utility being installed, unless specifically indicated otherwise.

C. Rock Excavation

Payment for rock excavation will be made under the bid item Rock Excavation. When no bid item exists and the Engineer agrees to pay for rock excavation, a unit price shall be negotiated.

D. Select Granular Backfill Materials

Payment for Select Granular Backfill materials will be in accordance with Section 112 except as further defined below.

Type 1 bedding material for water and sewer pipe installations described in sections 8 and 9 shall be considered incidental to the pipe being installed. And no direct payment for Type 1 bedding material will be made. Type 1 bedding material used as foundation material or for some use other than bedding for water or sewer pipes shall be paid for in accordance to section 112.

E. Imported Backfill

Payment for Imported Backfill will be made under the appropriate bid item for the material furnished and installed. Payment for Imported Backfill shall include all associated costs of excavation and disposal of excavated material unless otherwise called for in the Plans or Detailed Specifications. If suitable material was wasted from the project prior to encountering unsuitable material, measurement and payment for

imported backfill material will not be considered, provided a designated stockpile location was identified.

F. AASHTO T-180 Soil Test

Payment for providing the results of the AASHTO T-180 test shall be made under the bid item Modified Proctor Soil Test, Each and shall be full compensation for obtaining the soil sample, delivering it to the certified lab, conducting the test, and providing the Engineer with the results. Payment will be made for only those Proctor tests required by the Engineer.

END OF SECTION

SECTION 12

ROADWAY AND DRAINAGE EXCAVATION

12.1 DESCRIPTION

A. General:

This work consists of excavation and disposal of material within the limits of the work necessary for the construction of the roadway and not being removed under some other item.

Unclassified Excavation material is the property of the Owner. Unclassified Excavation materials designated as waste on the particular Contract may, at the direction of the Engineer, be utilized by the Owner at a different location. Unclassified Excavation material determined to be of no use to the Owner shall be disposed of at a Contractor provided waste site. The Engineer shall approve such site. Authority to designate what is usable or unusable shall be vested solely in the Engineer. See also Section 15.

B. Related Work Items:

Section 10	Clearing and Grubbing
Section 11	Utility Excavation and Backfill
Section 13	Removal Items
Section 14	Embankment
Section 15	Disposal of Surplus Excavation and Waste
Section 16	Optioned Borrow Excavation
Section 17	Salvaging, Stockpiling, and Placing Topsoil
Section 18	Erosion and Water Pollution Control
Section 190	Watering

12.2 MATERIALS

A. Unclassified Excavation:

Materials, except those which fall within the classification of Rock Excavation or Muck Excavation encountered during the construction of the work, regardless of their nature or manner in which they are removed, will be considered as Unclassified Excavation.

B. Rock Excavation:

Rock Excavation shall consist of removal and disposal of a sound and solid mass of mineral matter in place and of such hardness and texture that it cannot be loosened or broken down by ripping in a single pass with a tractor mounted hydraulic ripper

equipped with one digging point of standard manufacturer's design adequately sized and used with a crawler-type tractor rated between 370 and 460 net fly wheel horsepower, operating in low gear, with sufficient downward force on the ripper.

The Contractor shall keep accurate daily records of the quantity of rock removed so that a comparison can be made with the City's records.

The Contractor shall furnish, at no extra cost, an approved backfill material to fill the void left by rock excavation. He shall also provide, at no extra cost, a modified proctor (AASHTO T-180) moisture-density relationship curve for the furnished backfill.

C. Muck Excavation:

Muck excavation consists of the removal and disposal of saturated organic mixtures of soils and organic matter, which requires additional work or equipment not normally required for unclassified excavation.

D. Unclassified Excavation-Digouts:

This excavation consists of the removal and disposal of unstable material below an existing surface on which surfacing material is to be placed. When granular material is used for backfill, the excavated area shall extend to a daylight point or points such that lateral drainage is provided. The exposed undercut surface shall be satisfactorily compacted prior to backfilling. Unless otherwise permitted by the Engineer, existing surface gravel shall be salvaged before and replaced after the unsatisfactory material has been removed.

E. Water:

Water for compaction shall be furnished by the Contractor and shall be free from injurious matter. See also Section 190.

12.3 CONSTRUCTION REQUIREMENTS

A. Classification of Excavation:

Roadway and drainage excavation will be designated as Unclassified Excavation, Rock Excavation, Muck Excavation, or Unclassified Excavation-Digouts. Authority to identify and define the physical characteristics, which determine classification, shall be vested solely in the Engineer.

B. General:

Prior to beginning excavation, grading, and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 10.

The excavation and embankments for the roadway, intersections, and entrances shall be finished to smooth and uniform surfaces. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed.

Embankment construction shall be performed in accordance with Section 14.

Borrow material shall not be placed until after all usable excavated project material has been placed. Materials shall not be wasted without written permission of the Engineer. If the Contractor places more borrow than is required and causes a waste of excavation, the amount of waste shall be deducted from the volume as measured in the borrow area.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable soil, the Contractor shall remove the unsuitable materials and backfill to the finished graded section with approved material. Unsuitable material shall be disposed of as directed. The Contractor shall conduct operations in such a way that the Engineer can take the necessary cross-sectional measurements before the backfill is placed.

C. Salvage of Topsoil:

Topsoil that is to be used in topping the back slopes and other newly graded areas shall be removed from designated areas in accordance with Section 17. Topsoil that is not designated to be used as topping shall be salvaged to the location designated by the Engineer, or placed in the embankment in accordance with section 14.3.C.

D. Undercutting, Undercut Excavation and Material Selection:

When specified, select materials shall be utilized to improve the roadbed. The work shall be performed in such manner that suitable materials may be selected, removed separately, and deposited in the roadbed within the limits required.

On specified density projects, the Contractor shall undercut to the limits shown on the plans. Scarifying of the exposed surface will not be required. Undercutting excavation may include unclassified, rock or muck excavation as described on the plans.

Where shown on the plans, selected materials shall be utilized to improve the roadbed. The work shall be performed in such manner and sequence that suitable materials may be selected, removed separately, and deposited in the roadbed within the limits and elevations required.

On ordinary compaction projects, the Contractor shall, in order to obtain uniform compaction, do the following:

In cut sections, scarify or uniformly loosen with a disc or multi-toothed hydraulic ripper for the width of the subgrade, to a depth six (6) inches below the subgrade and re-compact to the required density. In shallow embankment sections (fills less than one and one-half (1 1/2) feet, not including subbase gravel), scarify for

the width of the subgrade six (6) inches below the existing ground surface. Sod existing in the top six (6) inches of subgrade shall be removed and replaced with satisfactory material.

E. Dirt/Dust Control

All activities associated with this contract shall conform to Rapid City Municipal Ordinance Chapters 8.34 through 8.44 and/or Pennington County Ordinance No. 12. The Contractor shall make every reasonable effort to minimize fugitive dirt or dust from construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions.

12.4 METHOD OF MEASUREMENT

When stipulated in the contract, the quantities of excavation for which payment will be made will be those shown in the contract (ie: plans quantity basis), provided the project is constructed to the lines and grades shown on the plans.

When no provisions are stipulated in the contract for payment of excavation as a plans quantity, final settlement may be made on a plans quantity basis, provided a written agreement between the Contractor and the City is executed prior to final measurement.

When payment is to be made on a plans quantity basis, whether provided in the contract or by written agreement, measurements will not be made except those necessary to determine that the work has been performed in conformance with the plans and to measure changes in plans or borrow pits which increase or decrease quantities of excavation.

When payment is to be made on a basis other than plans quantity, accepted quantities of various types of excavation will be measured in their original and excavated position by cross sectioning. Quantities of excavation, which conform to the staked lines and grades, may be computed using the original cross-sections and the staked section. Quantities of excavation that do not conform to the original plans lines and grades due to: changes in plans and grades, as directed by the Engineer; or over-breakage or slides not attributable to carelessness of the Contractor, will be measured separately and added to the area of the excavation.

The plan-shown quantity of undercutting excavation as described in Section 12.3D, first paragraph, with deductions made for portions not accomplished and with additions for portions not shown on the plans and ordered by the Engineer, will be measured separately for each class of excavation involved.

Measurement of excavation will include unsuitable material excavated and removed to obtain proper compaction in cut sections and in foundations for fill sections. Suitable material temporarily removed and replaced to facilitate compaction, except that removed for undercutting as required in Section 12.3D, first paragraph, will not be measured for payment.

Such affected areas will be measured, differences in quantities computed, and deductions or additions made as determined by the Engineer. Volume will be computed in cubic yards by the average end area method.

Where it is impractical to measure material by the cross-section method, acceptable methods involving three-dimensional measurements or measurement in the hauling vehicle may be used.

Unclassified Excavation to be performed in connection with box culvert construction will be limited to that within the right-of-way limits unless otherwise set forth in the plans. The measured quantity for this Unclassified Excavation will be the plan shown quantity.

12.5 BASIS OF PAYMENT

A. General:

Plans quantity will be the basis of payment unless otherwise shown. Completed and accepted work will be paid for at the contract unit price per cubic yard calculated to the nearest even cubic yard completed for the class of excavation involved.

Such payment will be full compensation for excavation, construction, and compaction of cuts and embankments, shaping of slopes, finishing of surface, disposal of surplus materials, preparation and completion of subgrade, shoulders, and roadway, and maintenance as specified herein. Such payment will also include the furnishing of equipment, tools, labor, supplies, and incidentals necessary to complete work included under Excavation.

Scarifying, shaping, and re-compacting, as required under Section 12.3.D, third paragraph, shall be absorbed and included in the unit price for excavation. Separate payment for this work will not be made.

B. Unclassified Excavation:

All excavation will be paid for at the contract unit price for Unclassified Excavation unless contract items provide for other classes of excavation.

When no bid item or other mention of Rock Excavation is shown on the plans and rock is encountered, such rock excavation as defined in Section 12.2.B will be paid for at a negotiated price. Notification shall be given to the Engineer far enough in advance to enable him to ascertain the extent and nature of the rock formation before removal of such rock is begun. Payment as rock excavation will not be made unless such notification is given.

When a mention of rock excavation is shown on the plans, and no item is provided, payment for such excavation will be made at the contract price for Unclassified Excavation, regardless of whether or not rock excavation is encountered at locations

other than those shown or if the total rock removed is greater than the estimated amount.

C. Rock Excavation:

When an item for Rock Excavation is provided in the contract, payment for such excavation will be made at the contract unit price for Rock Excavation.

D. Muck Excavation:

When an item for Muck Excavation is provided in the contract, payment for such excavation will be made at the contract unit price for Muck Excavation.

E. Unclassified Excavation-Digouts:

When an item for Unclassified Excavation Digouts is provided in the contract, payment for such excavation will be made at the contract unit price for Unclassified Excavation-Digouts.

F. Undercutting:

When an item for Undercutting is provided, payment for such will be at the contract unit price for Undercutting. Payment will be full compensation for work over and above that normally required for Unclassified Excavation.

G. Undercut Excavation:

When an item for Undercut Excavation is provided, payment for such will be made at the unit bid price for Undercut Excavation. Payment will be full compensation for excavating, replacing and compacting the material immediately below the finished subgrade surface and to the depth specified.

END OF SECTION

SECTION 13

REMOVAL ITEMS

13.1 DESCRIPTION

A. General:

This work shall include, but not be limited to: the removal and disposal of buildings, fences, structures, pavements; sawing of pavements prior to removal; and removal and disposal or salvage of abandoned pipe lines, pipe culverts, and other obstructions which are not designated or permitted to remain, except for obstructions to be removed and disposed of under other items in the contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits. When the proposal does not include pay items for removal items as set out in this section, such work shall be performed under various other contract items.

B. Related Items:

Section 15 - Disposal of Surplus Excavation and Waste
Section 19 - Incidental Work
Section 90 - Traffic Control

13.2 MATERIALS (not specified)

13.3 CONSTRUCTION REQUIREMENTS

A. Structure Removal:

Designated salvageable material shall be removed without unnecessary damage in sections or pieces, which may be readily transported and shall be stored by the Contractor at specified places. Unusable perishable material shall be destroyed or disposed of off the project. Nonperishable material may be disposed of outside the limits of view from the project with written permission of the property owner and in accordance with City Ordinance.

Basements or similar cavities left by structure removal shall be filled to the level of the surrounding ground and shall be compacted to the satisfaction of the Engineer under the same specifications as the embankment. Concrete basement floors and similar structures shall be broken up to prevent entrapment of water.

Bridges, culverts, and other drainage structures designated for removal and in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Unless otherwise directed, the substructures of existing bridges, culverts, and other drainage structures shall be removed down to the flow line of watercourse. Those parts outside of the stream shall be removed one (1) foot below natural ground surface. Where such portions of existing structures are within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Steel bridges and wood bridges, if designated, shall be dismantled without damage. Structures designated to become the property of the Contractor shall be removed to an approved site.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work. Blasting shall be accomplished according to the requirements stated in Section 7.

Pipe to be re-laid shall be removed, transported to a location approved by the Engineer and stored, when necessary, so that there will be no damage before relaying. The Contractor will be required to replace sections of pipe damaged by his negligence.

In removing manholes, catch basins, and drop inlets, any live sewers connected with them shall be rebuilt and properly reconnected. Satisfactory by-pass service shall be maintained during such construction operations. Any work on or removal of sanitary sewer or water facilities shall conform to Sections 8, 9, and 11.

- B. Paving Surface Removal: In removing pavement, curb, gutter, sidewalk, and similar structures where portions of the existing structures are to be left in the finished work, the old structure shall be removed to an existing joint or saw cut, and chipped, if necessary, to a true line with a vertical face. Openings in the existing pavement shall be made, by sawing to full depth of the pavement.

Protection of Existing Surface: Use of steel faced or shod equipment without adequate padding to prevent damage to the existing pavement shall be at the Contractor's risk. Extra care shall be taken to prevent damage from excavator, loader bucket, or other equipment edges/teeth when placing or removing trench spoil or materials piles. Damaged pavement because of the Contractor's equipment shall be repaired or replaced at no additional cost to the City.

Saw cutting of the pavement structure ahead of excavation operations shall be required to confine pavement damage to the limits of the trench or excavation. Initial saw cuts shall be made a minimum of one foot outside of the anticipated trench width or removal area. Asphalt or Portland concrete pavement shall be cut to full depth. Pavement removal limits shall be approved by the Engineer prior to sawing.

A second saw cut located one foot outside the trench limits will be required for all asphalt concrete removals. These second, final pavement saw cuts shall be full depth and shall be one (1) foot outside the initial cut. Final saw cuts shall provide a

smooth vertical face, against which to resurface. Care shall be taken to prevent damage to the newly cut edge.

Final removal area limits for Portland cement concrete excavation shall be as approved by of the Engineer. Minimum width of final removal shall be ½ panel on large panels and full panel on small panels.

If undermining of the asphalt concrete pavement edge occurs at any time during the construction, such undermined pavement must be saw cut back and removed to form a square edge and a straight and even alignment to a horizontal distance of at least one (1) foot beyond the edge of the undermined area. Removals for Portland cement concrete that has become undermined shall be as directed by the Engineer.

Where the existing street contains special subsurface drains or soil support fabric and where plans call for portions of such to remain, be extended, or be repaired, special removal techniques shall be as follows:

Streets that utilize basecourse over an engineering soil support fabric shall, upon removal of the asphalt or concrete pavement, be generally excavated down to the fabric with sufficient care to leave the fabric undamaged. Once the basecourse is removed, the fabric shall be cut allowing sufficient material to patch or connect to, the fabric laid back and the area excavated and backfilled with care to prevent damage to the fabric. When backfill is complete to the level of the fabric, the laid back fabric edges shall be laid flat over the backfilled area and covered with a new piece of similar fabric so that the edge of existing fabric is overlapped with new fabric to a minimum width of one and one half (1 ½) feet on either side of the undamaged, existing fabric edge. If the soils support fabric is inadvertently damaged by the Contractor, the Contractor shall notify the Engineer of the damage so that the Engineer may examine the extent of damage and direct the repair. Such repair shall be performed to the satisfaction of the Engineer and at the expense of the Contractor.

Special subsurface drains damaged by construction shall be repaired in kind at no expense to the City unless otherwise indicated in the Contract Documents.

Established drainage in the street, alley, or drainage ditch must be maintained by the Contractor during his construction operations. Contractor shall take necessary precautions to prevent drainage from running into the excavation.

Street and traffic signs within the excavation area shall be removed by the Contractor and delivered to the Rapid City Sign Shop. Care shall be taken to prevent damage to the signs, posts or hardware. New signs not specifically called out in the plans to be installed by the Contractor shall be erected by Sign Shop Personnel upon notification by the Contractor to the Traffic Operations Engineer that construction is sufficiently completed to enable sign installation. The Contractor shall give no less than twenty-four (24) hours' notice to the Traffic Operations Engineer.

Monuments, property pins, survey referenced points, and benchmarks shall not be disturbed without specific written permission from the Engineer. Any such markers disturbed without permission shall be replaced at the Contractor's expense by a licensed land surveyor.

City construction project plans will indicate known, existing monuments that are scheduled to be disturbed, demolished or removed.

Damage to the property of others, such as fences, trees, shrubs, lawns, sidewalks, etc. shall be repaired or replaced at the Contractor's expense, unless removal of such is shown on the plans or written permission was first obtained from the Engineer.

Monuments, property pins, survey referenced points, and benchmarks shall not be disturbed without written permission from the Engineer. Any such markers disturbed without permission, shall be replaced at the Contractor's expense, by a licensed land surveyor.

C. Dirt/Dust Control

All activities associated with this contract shall conform to Rapid City Municipal Ordinance Chapters 8.34 through 8.44 and/or Pennington County Ordinance No. 12. The Contractor shall make every reasonable effort to minimize fugitive dirt or dust from construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions.

13.4 METHOD OF MEASUREMENT

When the contract stipulates that payment will be made for removal of obstructions on a lump sum basis, the plans will list in detail the items to be removed.

When the contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit, stipulated in the contract.

When removal of pipe is to be made on a unit basis, the quantity will be measured in linear feet to the nearest tenth (0.1) foot. Quantities will be determined by measuring in place prior to removal. Flared end sections will be measured in linear feet at the flow line as part of overall length of pipe.

When removal of AC or PCC pavement or sidewalk is to be made on a unit basis, the quantity will be measured in square feet or square yards to the square foot or nearest tenth (0.1) square yard. Quantities will be determined by measuring in place prior to removal.

Where curb and/or gutter is adjoining Portland Cement Concrete pavement to be removed, it will be considered as pavement and will be measured as such.

When removal of obstructions will be on a unit basis, pavement sawing will be measured and paid for separately. Measurement for sawing of pavement shall be by the linear foot. Sawing limits shall be approved by the Engineer prior to sawing.

13.5 BASIS OF PAYMENT

Payment for removal of obstructions on a lump sum basis will be as set forth in Section 19.

Pipe removal, will be considered as Incidental Work unless a bid item for the removal is provided. Variance from pipe removal quantities, locations, or dimensions shown on the plans or specified herein will not be cause for adjustments in payment for Incidental Work.

Payment for removal of obstructions on a unit basis will be made under the appropriate bid item. Unless otherwise indicated the measurement of the unit will be to the nearest whole unit.

Payment for removal of obstructions by the Incidental work item, lump sum, or on a unit basis will be full compensation for removal and disposal of such items, excavation and subsequent backfill incidental to their removal. This payment will also include salvage of materials removed, their custody, preservation, storage, and disposal as provided herein or on the plans.

When there is a bid item provided, payment for sawing will be at the contract unit price per linear foot sawed. When no bid item is provided, sawing will be considered as incidental to the bid item for which it pertains.

END OF SECTION

SECTION 14

EMBANKMENT

14.1 DESCRIPTION

A. General:

This work consists of constructing roadway embankments, including preparation of the areas upon which embankments are to be placed; the construction of dikes within or outside the right-of-way; the placing and compacting of material within roadway areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area.

B. Related Work Items:

Section 11	Utility Excavation and Backfill
Section 12	Roadway and Drainage Excavation
Section 15	Disposal of Surplus Excavation and Waste
Section 17	Salvaging, Stockpiling, and Placing Topsoil
Section 18	Erosion and Water Pollution Control
Section 190	Watering

14.2 MATERIALS

Only materials approved by the Engineer shall be used in the construction of embankments and backfills.

14.3 CONSTRUCTION REQUIREMENTS

A. Preparation of Embankment Areas:

Undercutting shall be in accordance with Section 12. Sod, which is not within the volume of undercutting, shall be thoroughly disked before embankment is placed thereon.

When undercutting is not required and a compacted road surface containing granular material lies within three (3) feet of the subgrade surface, such old road surfacing shall be scarified or loosened with a disc or hydraulic ripper to a depth of at least six (6) inches. This scarified material shall be re-compacted to specified density.

When embankment is to be placed and compacted on hillsides, against existing embankments, or when embankment is built one-half (1/2) width at a time, the slopes that are steeper than 4:1, when measured at right angles to the roadway centerline,

shall be continuously benched as the work is brought up on horizontal layers. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous bench cuts. Material thus cut out shall be re-compacted to the specified density, along with the new embankment material at the Contractor's expense.

B. Finished Grade:

Unless otherwise specified, all embankment will be finished to grade with plus or minus one-tenth (0.1) foot tolerance.

C. Placing Embankment:

Sod or topsoil, where not specified by the Engineer to be salvaged, shall be used in the embankment and shall be well disked and pulverized. It may be placed in either the fill slopes outside the shoulders of the subgrade or spread in the lower one (1) foot of the fill between the roadbed shoulder lines, provided the sod or topsoil placed within the roadbed area is at least four (4) feet below the top of the subgrade. Sod or topsoil, shall not be placed within ten (10) feet of pipe culverts, or within fifty (50) feet of box culverts or bridges.

Rocks, broken concrete, or other solid materials shall not be placed in areas where piling is to be driven, underground utilities are to be installed or in other areas that the Engineer may designate.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing, or further breaking down the pieces resulting from excavation methods, such material maybe placed in the embankment in layers not exceeding in thickness the approximate average size of the larger rocks. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments or earth. Specified density will not be required for these layers; however, the material shall be compacted to the satisfaction of the Engineer. These layers shall not be constructed above an elevation one (1) foot below the finished subgrade. The top six (6) inches of embankments shall be essentially free of rock fragments or stone that cannot be hand-passed through a four (4) inch square opening.

Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed, with the permission and at the direction of the Engineer, on the side slopes of the nearest fill and placed to maintain a distinct shoulder line. Waste material shall be placed the maximum distance possible and at least one (1) foot below the finished shoulder elevation. In case it is impossible to dispose of all such material in the manner described, the remainder shall be disposed of as directed.

Embankments to be constructed through lakes or swamps shall be constructed by end-dump methods to an elevation, determined by the Engineer, where it is practical to start normal construction methods. Above this elevation, moisture and density requirements will apply.

Embankment materials shall be placed in horizontal layers not exceeding a loose depth of eight (8) inches and shall be compacted as specified before the next layer is placed. Material may be placed in lifts greater than eight (8) inches provided it has been demonstrated that the compacting equipment in use has the ability to compact such material to the required density for the entire depth of the lift.

Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Construction equipment shall be routed uniformly over the entire surface of each layer.

In areas composed mainly of bentonite or unstable material, the Engineer may require additional undercutting to a depth necessary to correct such areas. Scarifying of the exposed undercut surface will be required when specified on the plans or as directed by Engineer.

Rocks, two inches in diameter and larger, exposed at the surface within the right-of-way and easement areas shall be removed from the project site.

Driveway entrances, ditch and channel blocks, and dikes shall be constructed and compacted as directed by the Engineer.

Berms for structures requiring paved slope protection must be finished to grade with plus or minus one-tenth (0.1) foot tolerance to provide a true and positive support for the slope paving. Other berms will be neatly finished to the same tolerance as the remainder of embankment.

When the foundation for a box culvert, or any portion thereof, is constructed of compacted embankment, the embankment shall be constructed to an elevation between the bedding grade and flow line grade, as shown on the plans or established by the Engineer.

Backfill moisture and density shall be determined at least every 200 feet horizontally and every three (3) feet vertically. Backfill shall be properly compacted at all depths. The Contractor shall not place the finished surface (asphalt, curb & gutter, grass, etc.) until the specified densities are met at each location and the Engineer gives his approval. Backfill material not meeting specified densities shall receive additional compaction or shall be removed and replaced at no extra cost to the City as necessary to meet specifications.

When specified moisture contents are not met, the Contractor has the options of drying wet soil, furnishing approved soil meeting specifications, or adding water to

dry soil as necessary to meet specifications. If water is added to dry soil, it must be thoroughly mixed with the soil to provide uniform moisture content prior to backfilling.

The Contractor shall provide for positive drainage away from the excavation and embankment or otherwise take steps to protect the excavation and embankment from becoming excessively wet prior to placing the finished surface.

Should the Engineer determine that any portion of the backfill or excavation has become excessively wet after placement, the Contractor shall remove the material to the satisfaction of the Engineer and furnish an approved backfill material meeting the above specifications.

The Contractor shall be responsible for the stability of constructed embankments prior to acceptance and shall replace or reconstruct any portions, which have failed at no additional cost to the City.

Watering of embankments, or use of moist soils in embankments without watering will not be permitted during freezing weather.

Watering, and the work incidental thereto, shall be done as set forth in Section 190.

D. Compaction, Specified Density Method:

The Contractor shall compact all embankment according to the following table:

<u>SOIL TYPE</u>	<u>BACKFILL MOISTURE CONTENT</u>	<u>DEGREES OF COMPACTION</u>
Cohesive	3% below to 8% above Optimum	Min of 92% of Maximum Dry Density
Cohesion less	Workable	Minimum of 95% of Maximum Dry Density

Maximum dry density and optimum moisture content shall be determined by the AASHTO T-180, Modified Proctor Test.

1. Soil Tests: Prior to the start of construction, the Contractor shall provide the Engineer with the results of a modified proctor soil compaction test, as determined by the AASHTO T-180 Test, for those locations and depths marked on the plans. If no locations are indicated on the plans, proctor test results shall be provided for locations determined by the Engineer.

Along with the test results, the Contractor shall provide the Engineer with no less than 25 pounds of each sample appropriately labeled with the project title, the location from which the sample was obtained, the date of sample collection, and name of the person who collected the sample, and the name of the person or

firm who conducted with compaction test. A City Inspector shall be present during sample collection.

2. Testing Frequency: Initially, soil samples will be required only at those locations indicated on the plans. However, should it become apparent during construction that the soil types encountered are significantly different from the initial samples, additional sampling and testing may be required.

Unless otherwise specified in the Detailed Specifications, field density tests, will be performed by the Engineer. The field density shall be measured with a nuclear density machine in accordance with Test No. SD114 (AASHTO T 238). Contractor will be required to provide a prepared surface in the embankment shaped to facilitate testing at locations requested by the Engineer.

E. Compaction, Ordinary Compaction Method:

Compaction may be accomplished with any type of equipment, which will give uniform satisfactory results.

A rolling procedure shall be established which will produce densities conforming to Section I4.3D. Sufficient density tests will be taken to insure that the required density is being obtained with the equipment, soil and procedure being used. Once the procedure has been established, further density tests will be taken only when deemed necessary by the Engineer.

Each layer under construction must be satisfactorily compacted before the next layer is placed. Rolling work shall also be extended to cover the subgrade width in completed cut-sections under the same general requirements, and without any additional compensation. Cut-sections excavated below grade and refilled with the removed excavation or with selected soils shall be compacted in the same manner as embankments.

F. Dirt/Dust Control

All activities associated with this contract shall conform to Rapid City Municipal Ordinance Chapters 8.34 through 8.44 and/or Pennington County Ordinance No. 12. The Contractor shall make every reasonable effort to minimize fugitive dirt or dust from construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions.

14.4 METHODS OF MEASUREMENT

Final measurement of embankments as a pay item will not be made.

14.5 BASIS OF PAYMENT

Embankments, including all the work (labor and equipment) specified in this section, will not be paid for directly but shall be understood to be subsidiary work pertaining to the several classes of excavation.

Payment for AASHTO T-180 proctor_density_tests shall be on a, per each basis.

Contractor provided field density tests, shall be incidental to the several classes of excavation, unless provided for in the Bid Proposal. In such case, payment shall be as called out in the Detailed Specifications.

END OF SECTION

SECTION 15

DISPOSAL OF SURPLUS EXCAVATION AND WASTE

15.1 DESCRIPTION

A. General:

This work consists of disposal of surplus excavation and waste materials from whatever source.

B. Related Work Items:

Section 10 - Clearing and Grubbing
Section 11 - Utility Excavation and Backfill
Section 12 - Roadway and Drainage Excavation
Section 13 - Removal Items
Section 14 - Embankment
Section 16 - Optioned Borrow Excavation

15.2 MATERIALS (Not Specified)

15.3 CONSTRUCTION REQUIREMENTS

Surplus excavation and waste material shall be disposed of as shown on the plans, or if not shown on the plans, in such other places as directed or approved by the Engineer.

All waste material not desired by the Owner, shall be disposed of as directed by the Engineer and in accordance with City Ordinance.

Authority to designate what is surplus and waste shall be vested solely in the Engineer.

Asphalt pavement removed under a City contract may be hauled to a stockpile at the City landfill. If the City Landfill is utilized, the Contractor shall coordinate with the Solid Waste Superintendent.

15.4 BASIS OF PAYMENT

This work will not be paid for directly, but shall be understood to be subsidiary work pertaining to the several classes of excavation.

Fees for disposing asphalt pavement at the City Landfill shall be as negotiated with the Solid Waste Superintendent.

END OF SECTION

SECTION 16

OPTIONED BORROW EXCAVATION

16.1 DESCRIPTION

A. General:

This work consists of the removal and utilization of material obtained from optioned sources.

B. Related Work Items:

Section 10 - Clearing and Grubbing
Section 12 - Roadway and Drainage Excavation
Section 14 - Embankment
Section 15 - Disposal of Surplus Excavation and Waste
Section 17 - Salvaging, Stockpiling, and Placing Topsoil
Section 70 - Seeding
Section 71 - Fertilizing
Section 72 - Mulching

16.2 MATERIALS (not specified)

16.3 CONSTRUCTION REQUIREMENTS

- A. Suitable materials removed from optioned borrow sources shall be used in the formulation of embankments as set forth in Section 14.

Optioned borrow sources shall be left and maintained in a suitable condition for accurate measurement and pleasant appearance, and in accordance with grades, slopes, and other requirements of the option agreement.

- B. Replacement of topsoil, fertilizing, seeding, and other operations necessary for restoration of the pit shall be done in accordance with the terms of the contract.

16.4 METHOD OF MEASUREMENT

Optioned borrow excavation will be measured in its original position by cross sectioning. Final cross-sections will be taken following replacement of topsoil. Volumes will be computed in cubic yards to the nearest whole cubic yard by the average end area method.

The quantity of salvaged topsoil which is stockpiled from the optioned borrow sources will be added to and included as option borrow excavation.

Seeding, fertilizing, and mulching for optioned borrow will be measured as per Sections 70, 71, and 72 respectively, unless modified by other contract provisions.

The quantity of topsoil stockpiled and replaced on optioned borrow sources will be determined by measuring the stockpiles just prior to removal of the material from such stockpiles.

16.5 BASIS OF PAYMENT

Optioned borrow excavation will be paid for at the contract unit price per cubic yard. Payment will be full compensation for furnishing the material on the project and for furnishing materials (except topsoil), labor and incidentals required for restoration of the pit to the specified condition.

Topsoil which is stockpiled and replaced on the optioned borrow source will be paid for at the contract unit price per cubic yard for "Placing Topsoil".

Seeding, fertilizing, and mulching for optioned borrow will be paid for as per Sections 70, 71 and 72 respectively, unless modified by other contract provisions.

END OF SECTION

SECTION 17

SALVAGING, STOCKPILING, AND PLACING TOPSOIL

17.1 DESCRIPTION

A. General:

This work consists of excavating, hauling, stockpiling, depositing and spreading topsoil and preparing the area.

B. Related Work Items:

Section 10 - Clearing and Grubbing
Section 12 - Roadway and Drainage Excavation
Section 14 - Embankment
Section 16 - Optioned Borrow Excavation
Section 70 - Seeding
Section 71 - Fertilizing
Section 72 - Mulching

17.2 MATERIALS (Not Specified)

17.3 CONSTRUCTION REQUIREMENTS

A. Salvage:

Topsoil shall be selected from the regular grading areas or from other areas shown on the plans or designated by the Engineer. Areas from which topsoil is to be excavated shall be cleared of objectionable vegetation, and all litter such as brush, rock, or foreign material of objectionable size or quantity in accordance with Section 10, Clearing and Grubbing. Topsoil shall be excavated in sufficient volume, if available, to cover the designated areas to the required depths.

Salvaged topsoil may be stockpiled, when necessary, in convenient locations within the right-of-way for subsequent spreading and placing. When operations of the Contractor do not permit stockpiling of topsoil within the right-of-way, it shall be the Contractor's obligation to arrange for stockpile sites at his own expense, unless otherwise provided in the contract. The stockpiles shall be shaped and smoothed to permit accurate measurements.

Stockpile areas shall be left and maintained in a neat condition. Stockpiles shall be covered or seeded to prevent wind and/or water erosion. Stockpiles covering an area

one acre or more in size, which will remain in place after Project Completion, require an Air Quality Continuous Operation Permit.

B. Preparation of Roadway:

Areas designated to be covered with salvaged topsoil shall be undercut or under filled so that the finished lines will conform to the template lines on the cross sections after the topsoil has been placed.

The areas on which topsoil is to be placed shall be smoothed to a condition satisfactory for the placement of topsoil.

C. Placing:

The areas to be covered with topsoil shall be as designated on the plans. Topsoil shall be spread evenly and uniformly over the designated areas to the plan designated depth. If topsoil is not available in sufficient quantities to cover the designated areas to the plan specified depth, the Contractor shall spread the available topsoil as directed by the Engineer.

D. Dirt/Dust Control

All activities associated with this contract shall conform to Rapid City Municipal Ordinance Chapters 8.34 through 8.44 and/or Pennington County Ordinance No. 12. The Contractor shall make every reasonable effort to minimize fugitive dirt or dust from construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions.

17.4 METHOD OF MEASUREMENT

A. Salvaged Topsoil:

Measurement for removal of topsoil from its original position will be made by the nearest whole cubic yard of volume. Measurement will not be made unless such removal is designated on the plans or directed by the Engineer. The method of measurement for removal of topsoil from under embankments will be made by measuring the topsoil stockpiles.

B. Placing Topsoil:

The cubic yards of topsoil to be measured shall be the quantity of topsoil removed from stockpiles and placed on the designated areas. If necessary, measurements will be made just prior to removal of the material from such stockpiles.

17.5 BASIS OF PAYMENT

A. Salvaged Topsoil:

This work will be paid at the contract price per cubic yard for "Unclassified Excavation" to the nearest whole cubic yard. This payment will be full compensation for excavation and stockpiling of topsoil.

This payment will also be full compensation for placement operations in the event topsoil is not stockpiled prior to placement on the designated areas.

Payment will not be made for necessary undercutting to provide space for topsoil covering, except that payment will be made for such undercutting when stockpiled topsoil is to be placed under a subsequent contract. In this case, payment will be paid at the contract price per cubic yard for "Unclassified Excavation" to the nearest whole cubic yard.

Separate payment will not be made for haul under this item.

B. Placing Topsoil:

The placement of stockpiled topsoil will be paid for at the contract price per cubic yard for "Placing Topsoil" to the nearest whole cubic yard. Payment for "Placing Topsoil" will be plans quantity unless otherwise noted.

This payment shall be full compensation for labor, equipment, tools and incidentals necessary for removing topsoil from stockpiles, hauling, depositing, spreading and finishing of topsoil.

Separate payment will not be made for haul under this item.

END OF SECTION

SECTION 18

EROSION AND WATER POLLUTION CONTROL

18.1 DESCRIPTION

A. General:

This work consists of temporary measures necessary to control erosion and water pollution during the life of the contract.

The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features specified elsewhere in the contract to the extent practical to assure economical effective and continuous erosion control throughout the construction and post-construction period.

B. Related Work Items:

- Section 10 - Clearing and Grubbing
- Section 11 - Utility Excavation and Backfill
- Section 12 - Roadway and Drainage Excavation
- Section 14 - Embankment
- Section 15 - Disposal of Surplus Excavation and Waste
- Section 16 - Optioned Borrow Excavation
- Section 17 - Salvaging, Stockpiling, and Placing Topsoil
- Section 66 - Slope Protection
- Section 67 - Fabric Formed Concrete Mat
- Section 68 - Bank and Channel Protection Rock Filled Wire Baskets
- Section 69 - Bank Protection Gabions
- Section 70 - Seeding
- Section 71 - Fertilizing
- Section 72 - Mulching
- Section 73 - Sodding
- Section 109 - Riprap and Slope Materials
- Section 125 - Gabions
- Section 202 - Engineering Fabric

18.2 MATERIALS

Materials used in erosion and water pollution control work shall conform to the requirements set forth in the contract. When work is ordered for which no provisions are contained in the contract, material requirements shall be set forth in the agreement covering the additional work.

18.3 CONSTRUCTION REQUIREMENTS

A. Sequence:

The Contractor will be required to perform erosion and water pollution control measures in the sequence and manner outlined in the contract, unless otherwise ordered by the Engineer. Additional erosion and water pollution control measures found necessary after award of the contract shall be performed at such times and in the sequence ordered by the Engineer.

B. Prosecution:

The Contractor shall submit for approval at the pre-construction conference, his proposed schedule and method of operation for performance of temporary and permanent water pollution control measures.

Erosion and water control measures shall be continued in an orderly and progressive manner to the extent considered feasible and justified.

The Engineer has the authority to direct the Contractor to provide immediate permanent or temporary erosion and water pollution control measures to prevent contamination of adjacent streets, properties, streams or other watercourses, lakes, ponds, or other areas of water impoundment. Such work may involve the construction of temporary structures, berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion.

Potential pollutants used during construction shall be stored or disposed of where runoff will not carry them into streams or lakes. Pollutants shall not be disposed of in streams or lakes.

Contractor equipment yards and service areas shall be located or bermed so runoff from the areas and pollutants do not reach waterways or impoundments of water.

In the event of conflict between these requirements and pollution control laws, rules, or regulation of other Federal or State or local agencies, the more restrictive laws, rules or regulations shall apply.

18.4 METHOD OF MEASUREMENT

Erosion control measures shown on the plans will be measured as provided in the applicable specification for the contract items involved.

Erosion control measures not covered by contract items will be measured as extra work in accordance with Section 7 of this specification.

18.5 BASIS OF PAYMENT

Erosion control measures shown on the plans will be paid for at applicable contract unit prices.

Erosion control measures not covered by contract items will be paid for as extra work in accordance with Section 7, General Conditions.

Erosion control measures, which are required due to the Contractor's negligence, carelessness, or failure to install permanent controls, as a part of the work as scheduled, will be performed by the Contractor at no expense to the City.

END OF SECTION

SECTION 19

INCIDENTAL WORK

19.1 DESCRIPTION

A. General:

This work includes all miscellaneous items not included under the regular items covered by unit prices as listed on the plans or specifications or in the proposal, but which must be performed in order to properly complete the contract.

B. Related Work Items:

(Not specified, but includes all pertinent work items.)

19.2 MATERIALS (Not Specified)

19.3 CONSTRUCTION REQUIREMENTS

Incidental work will be listed in detail on the plans and/or in the detailed specifications. This work shall be performed in an approved and workmanlike manner to properly facilitate the whole of the work, and as directed by the Engineer.

19.4 METHOD OF MEASUREMENT

Field measurement for the item of Incidental Work will not be made.

19.5 BASIS OF PAYMENT

Payment for incidental work, as listed on the plans and in the proposal, will be the lump sum bid amount listed in the proposal. Payment on this basis shall be full compensation for labor and equipment necessary to perform all work listed on the plans as incidental work. Partial payment, when allowed, shall be made according to the following schedule, unless otherwise modified by the Engineer in the Contract:

(See back of this sheet)

Percentage of Contract Amount Completed (Excluding Incidental Work Itself)	Percentage of Incidental Work Paid
Five Percent (5%)	Twenty-Five Percent (25%)
Twenty Percent (20%)	Fifty Percent (50%)
Thirty-Five Percent (35%)	Sixty Percent (60%)
Fifty Percent (50%)	Seventy Percent (70%)
Seventy-Five Percent (75%)	Eighty Percent (80%)
One Hundred Percent (100%)	One Hundred Percent (100%)

END OF SECTION

SECTION 20

GRANULAR MATERIALS

20.1 DESCRIPTION

A. General:

This work consists of furnishing and placing one or more courses of crushed rock aggregate on a prepared surface.

B. Related Work Items:

Section 64 - Under-drains

Section 111 - Crushed Aggregate for Maintenance

Section 117 - Aggregates for Granular Bases and Surfacing

Section 202 - Engineering Fabric

20.2 MATERIALS

Granular materials of the type specified on the plans or in the specifications shall conform to the requirements set forth in the appropriate Sections.

Granular additives (sand, rock, etc.) may be necessary to produce material of the type specified.

20.3 CONSTRUCTION REQUIREMENTS

A. Preparation of Roadway:

Prior to placement of granular material, required excavation and/or embankment shall be performed so that the finished lines and grades will conform to the template lines on the cross sections and in accordance with the appropriate Sections of these Specifications.

B. Processing and Mixing:

When granular material is laid by means other than an approved spreader, the material shall be dumped and formed into a uniformly shaped windrow. The quantity of material in the windrow will be limited to that necessary to construct a compacted layer with a maximum four (4) inch thickness. The material shall be placed in a windrow, spread uniformly, and watered and worked in a manner such that segregation of materials is minimized.

Each layer shall be compacted to the specified densities before the next lift is placed thereon.

Unless otherwise shown on the plans or in the specifications, the required density shall be ninety-five percent (95%), minimum, of the maximum dry density as determined by AASHTO T 180. When called for in the Detailed Specifications, the Contractor shall provide field density testing at the rate and frequency specified or as directed by the Engineer. Field density shall be measured with a nuclear density machine in accordance with Test No. SD114 (AASHTO T 238).

The rollers for compaction shall be pneumatic-tired, with an effective roller weight of not less than two hundred fifty (250) pounds per inch of roller width. Vibratory compacting smooth steel faced equipment may be used in lieu of the above-specified rollers.

C. Base Course or Gravel Cushion:

When the base course surface is to be primed under the base course contract, the final rolling of the top surface of the base course shall be accomplished in such a manner as will embed as many of the loose stones as possible.

D. Gravel Surfacing:

When the gravel surfacing is ready to place, the Contractor shall spread it evenly to the specified width, or as directed by the Engineer. Watering of the material shall be accomplished during the spreading operation. Rolling shall proceed simultaneously with the spreading and watering operations and continue in parallel overlapping strips until the entire area has been rolled at least twice.

Density requirements are not specified, but a uniform, stable surface shall be maintained.

E. Dirt/Dust Control:

All activities associated with this contract shall conform to Rapid City Municipal Ordinance Chapters 8.34 through 8.44 and/or Pennington County Ordinance No. 12.

The Contractor shall make every reasonable effort to minimize fugitive dirt or dust because of construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions.

20.4 METHOD OF MEASUREMENT

Granular materials will be measured to the nearest one-tenth (0.1) ton. The Contractor shall provide weigh tickets for all materials furnished, installed, and accepted, showing gross, tare & net weights, project, truck, time, and initials of the scale operator within 48

hours of placement. Weighing shall be done on a SDDOT certified scale. Weigh tickets meeting the above standards will be considered valid.

20.5 BASIS OF PAYMENT

The accepted quantities of granular material will be paid for at the contract price per ton complete in place. Tickets delivered after 48 hours will not be considered valid and will not be paid for.

In the event a separate item for ordinary roadway shaping is not provided in the Bid Proposal for use in connection with granular material construction, payment for the granular material will be full compensation for necessary shaping work.

In the event that Contractor provided field density testing is required, payment shall be at the unit bid price provided in the Bid Proposal. In the event that no unit price for field density tests is provided in the Bid Proposal, such work shall be incidental to the granular material and no separate payment will be made for field density testing.

END OF SECTION

SECTION 31

ASPHALT CONCRETE - GENERAL

31.1 DESCRIPTION

A. General

These specifications include general requirements that are applicable to all types of asphalt pavements of the hot mix type, irrespective of gradation of aggregate, kind and amount of asphalt material, or pavement use. Exceptions to the general requirements are indicated in the specific requirements for each class.

This work consists of one or more courses of asphalt mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the class under contract.

B. Related Work

- Section 32 - Asphalt Concrete - Class E
- Section 33 - Asphalt Concrete - Class G
- Section 34 - Asphalt Concrete - Class S
- Section 35 - Prime, Tack, and Flush Seal Coats
- Section 37 - Asphalt Surface Treatment
- Section 39 - Cold Mix Asphalt Concrete
- Section 40 - Portland Cement Concrete Pavement
- Section 41 - Utility Trench Resurfacing
- Section 115 - Aggregates for Asphalt Concrete
- Section 116 - Aggregates for Asphalt Surface Treatments
- Section 118 - Asphalt Material

31.2 MATERIALS

A. Composition of Mixtures

The asphalt concrete shall be composed of a mixture of aggregate and asphalt. The several aggregate fractions shall be combined in such proportions that the resulting mixture meets the gradation requirements of the specifications.

The operation of the plant shall not commence until the Contractor has furnished the Engineer, in writing, a job mix formula established by a certified testing laboratory meeting the criteria for the class of asphalt concrete specified. After the job mix formula is established, the mixture shall conform within the range of tolerances for that class of asphalt concrete.

The job mix formula testing for each class of asphalt concrete used shall be updated annually by a certified testing laboratory at the beginning of the construction season and used for that construction season only.

A change in sources of materials will require a new job mix formula to be established before the new material is used. When unsatisfactory results or other conditions make it necessary, the Engineer may require the Contractor to furnish a new job mix formula, as established by a certified testing laboratory.

B. Aggregates

Aggregates shall meet the applicable requirements of Section 115.

C. Asphalt

Asphalt, of the type specified in the job mix formula, shall meet the applicable requirements of Section 118 or as called for in the Detailed Specification.

31.3 CONSTRUCTION REQUIREMENTS

A. Weather and Seasonal Limitations

Asphalt concrete shall only be constructed or placed when the underlying surface material is dry and unfrozen. Asphalt concrete shall not be placed when weather conditions prevent proper handling, compaction, or finishing. Temperature and seasonal limitations are as follows except as allowed by the Engineer:

MINIMUM AIR TEMPERATURES AND SEASONAL LIMITATIONS

<u>Compacted Thickness</u>	<u>Surface Course</u>		<u>Subsurface Course & Shoulder Courses</u>		
	<u>Min. Temp.</u>	<u>Seasonal Limits</u>	<u>Min. Temp.</u>	<u>Seasonal Limits</u>	
1 in. or Less	45° F	May 1 to Nov. 1	40° F		None
Over 1 in. to 2 in.	40° F	May 1 to Nov. 1	35° F		None
Over 2 in. to 3 in.	35 F	May 1 to Nov. 1	32 F	None	

B. Equipment:

1. Requirements for All Plants

The central plant for mixing the mineral aggregate and asphalt may either be of the batch, continuous, or drum mix type. Batch or continuous type shall have at least two (2) storage bins, protected from the weather and of sufficient capacity to furnish the necessary amount of mineral aggregate materials when operating at the calibrated capacity of the plant. The bin capacity shall be so proportioned as to insure adequate storage of the hot, dried, and screened mineral aggregate divided on the one-fourth (1/4) inch sieve, or other sieve size agreed upon. Each

compartment shall have an overflow pipe that prevents any diversion of excess material into other compartments.

Vibrators shall be provided to prevent bridging or arching of the contents in the bins. Adequate and convenient facilities shall be provided to obtain representative aggregate samples from each bin. When material filler or hydrated lime additive is required, a separate bin and feed system shall be provided to store and accurately and uniformly proportion the required quantity into the mixture.

The central mixing plant shall be equipped with a dust collector. The device shall be operated to eliminate or conserve the dust necessary to meet gradation limits.

The central mixing plant shall be equipped with a dryer or driers, which continuously agitate the mineral aggregate during the heating and drying process. The dryer or driers shall be capable of preparing aggregates needed to operate the calibrated capacity of the plant.

Burner fuel used for production of asphalt concrete shall be propane, butane, natural gas, Grade 1 fuel oil, Grade 2 fuel oil, Grade 4 fuel oil (light), Grade 5 fuel oil (light or heavy). Fuel oil heavier than Grade 2 shall meet the requirements of ASTM D396. Recycled oils, RF04, RF05L, RF05H may be used provided they meet the requirements of ASTM D6448. The Contractor shall certify that each load of fuel meets the applicable ASTM specification. Recycled fuel oils and fuel oil heavier than Grade 2 shall be properly preheated and shall be efficiently burned. Production of mix shall be stopped, if flameouts or signs of incomplete combustion occur.

A pyrometer or other thermometric instrument shall be installed in the supply line between the storage tank and the discharge point in the plant to indicate the temperature of asphalt. The mixing plant shall not operate unless the thermometric instruments are in place and working properly. The plant shall be equipped with satisfactory weighing or volumetric equipment. The equipment shall provide devices that will permit easy readjustment of any working part that may get out of adjustment.

Asphalt storage tanks shall be kept level. Accurate calibration charts shall be furnished to the Engineer and shall show the quantity of material contained in a tank at each inch increment of depth. A suitable measuring device to obtain the depth of material shall be provided. Storage tanks shall be capable of uniformly heating the material, under effective and positive control to the temperature requirements. Heating shall be accomplished by steam coils, electricity, or other means, so that the flame will not come in direct contact with the heating tank. The circulating system for the asphalt shall be of adequate size to insure proper and continuous circulation during the entire operating period. An accurate thermometer must be installed in the tank so the temperature can be monitored.

Bins for hot mix storage shall be constructed so that mix drawn from the bins will meet all of the specified requirements of the mixture.

2. Specific Requirements for Continuous Type Mixing Plants

The plant shall include a continuous mixer capable of adequately heating and producing a uniform mixture. The discharge hopper shall be equipped with dump gates, which will permit rapid and complete discharge of the mixture. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The clearance between the paddles and the mixer liner shall not exceed one (1) inch.

The proportioning device (gradation unit) for mineral aggregate shall be equipped with accurately controlled gates or orifices for volumetrically measuring the material as it is fed by a conveyor to the mixer and constructed so the flow of aggregates can be accurately determined and positively controlled. A cut-off system shall automatically stop the mixing operation when the level of the aggregate in any bin is less than fifteen (15) inches above the apron feeder. An accurate revolution counter shall be provided on a plant drive, which is interlocked with the conveyor to the mixer and shall be easily accessible for reading.

Bypass gates for obtaining test samples shall be provided for calibration of gate openings. The volumetric proportioning device for the asphalt shall be a positive displacement-metering pump with a satisfactory nozzle arrangement in the mixer. The operating speed of the pump shall be synchronized with the flow of mineral aggregate to the mixer by an automatic interlocking control. The device shall be easily and accurately adjustable to vary the rate of asphalt delivered to the mixer so the mixture will be uniformly proportioned. An accurate meter showing the input of asphalt to the mixer from the pump will be required.

A recording pyrometer shall be mounted in the discharge end of the mixer, and daily charts of contiguous mix temperature readings shall be submitted to the Engineer. The pyrometer shall be of a type and at a location that is easily accessible for readings.

3. Specific Requirements for Batch Type Mixing plants

The batch mixer shall be capable of producing a uniform mixture, and the mixer box shall be equipped to prevent loss of dust. The clearance between the paddles and the mixer liner shall not exceed one (1) inch.

Batch plants shall be fully automatic to the extent that the only manual operation required will be for the proportioning of one batch utilizing a single actuation switch or starter.

The automatic unit shall include a timing unit to automatically control the measuring, mixing, and dumping processes through a central control.

The automatic unit shall be self-contained. If the unit is affected by vibration, it shall be set on the ground or mounted on a vibration-free surface.

The automatic unit shall be capable of performing the following operations in the proper sequence and time interval:

- a. The automatic process control in conjunction with the timing unit shall automatically dump preset weights of the materials into the pugmill or mixer in proper time sequences.
- b. When the materials are low in supply, a cutoff system shall automatically stop the weighing process until the quantity of material required for one batch is available. In lieu of this requirement, the automatic control unit shall be equipped with an over-under weight control device, which automatically stops the weighing process when the weight of a component in the batch varies from the preset weight by more than the following listed tolerances:

Aggregate Components.....	± 1.5% of total batch weight
Mineral Filler.....	± 0.5% of total batch weight
Asphalt.....	± 0.3% of total batch weight

- c. The mixer cannot be emptied until the end of the preset mixing time.
- d. The automatic control unit shall prevent the introduction of mix ingredients into the mixer while the dump gate is open.
- e. The asphalt and the aggregate measuring processes shall be controlled by separate sets of components contained within the automatic unit and shall be capable of performing both processes simultaneously.
- f. The weight or volume of the asphalt introduced into the batch, shall be indicated by the dial pointer.
- g. The unit shall be capable of converting the control of the measuring and mixing processes from automatic to manual operation at any time.

In conjunction with the automatic unit, a time lock device shall be used which is capable of controlling the operations of a complete mixing cycle. The weigh-box gate shall lock after charging the mixer and until the closing of the mixer gate at the completion of the cycle. The asphalt bucket or the volumetric control shall lock throughout the dry mixing period, and the mixer gate shall lock throughout the dry and wet mixing periods. The dry mixing period shall be the interval of time between the opening of the weigh box gate and the start of the application of asphalt. The wet mix period shall start at the beginning of the application of asphalt and shall end when the mixer gate is opened.

The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle of not less than three (3) minutes.

A mechanical batch counter shall be installed as part of the timing device to register the release of the batch. Spring-less dial or beam scales, accurate to one-half (1/2) of one percent (1%) of the net load, are required on all batch plants.

Where the asphalt is weighed, scales or weights shall be attached to the bucket in a manner that will accurately weigh the amount of asphalt going into the mixer. A tilting bucket will not be permissible. Weighing or measuring equipment shall be sealed or locked in place and periodically checked by the Engineer to secure the required accuracy in the mix.

A recording pyrometer shall be mounted in the discharge chute of the dryer. Daily charts of continuous aggregate temperature readings may be required to be submitted to the Engineer. The pyrometer shall be of a type and at a location that is easily accessible for reading without difficulty.

4. Specific Requirements for Drum Mix Plants

The dryer drum shall be designed to uniformly heat, coat, and mix the materials without burning or adversely affecting the mixture.

- a. The component aggregates shall be processed, stockpiled, and proportioned as provided herein.
- b. The aggregate and asphalt shall be fed simultaneously into the dryer to uniformly heat, mix, and coat the aggregate.
- c. The aggregate feed system into the dryer shall provide positive control of the aggregate feed that can be easily and accurately calibrated. The rate of feed shall be continuously monitored, by belt scale or other device, displayed for the plant operator, and interlocked with the asphalt metering mechanism. Provisions for obtaining representative samples of the combined aggregate prior to its introduction into the dryer shall be provided.
- d. The asphalt metering mechanism shall provide positive control of the rate asphalt is introduced into the mixture and shall respond instantaneously to variation in the aggregate feed rate that would alter the established asphalt content. The mechanism shall be easily and accurately adjustable for change in the rate of asphalt delivered.
- e. A pyrometer or other thermometric instrument shall be installed in the supply line between the storage tank and the discharge point in the dryer to accurately indicate the temperature of the asphalt.
- f. The system shall be equipped with automatic burner controls regulated by temperature sensing of either the mixture at point of discharge from the dryer drum or the stack temperature.

- g. Production shall be limited to the rate required to obtain satisfactory aggregate coating and a uniform mixture meeting job mix temperature requirements.
- h. The mixture shall be conveyed from the dryer discharge to a storage bin for loading into haul units. The storage bin shall be designed and charged in a manner, which prevents segregation of the mix.

5. Pavers

Self-propelled pavers shall be equipped with a sufficient capacity hopper having a bottom conveyer, an activated screed or activated strike-off assembly, heated if necessary, and is capable of laying specified lane widths. The paver shall provide an accurate, smooth, uniform-textured spread and provide preliminary compaction of the mixture.

An attachment shall be provided on the paver that will place a satisfactory beveled edge on the mat if called for on the plans.

Pavers shall be equipped so that the height and transverse slope of the screed may be manually controlled. They shall be capable of depth adjustments from three-quarters (3/4) inch to not more than three (3) inches and width adjustments to spread the mixture in strips of less than ten (10) feet in width, in steps of one (1) foot or less, to a minimum width of eight (8) feet. They shall be equipped with blending or joint leveling devices for smoothing and adjusting all longitudinal joints between adjacent strips of courses of the same thickness.

6. Rollers

Rollers for compacting the asphalt concrete shall be of the self-propelled type, capable of producing a smooth surface finish.

The number and weight of rollers furnished shall be sufficient to compact the mix to the required density while it is in a workable condition.

Rollers shall be equipped to prevent "pickup" on the tires or drums. Provisions for uniform moistening of the drums or tires with water or water detergent solution or suitably enclosing the roller to prevent heat loss from the tires may be required. The use of fuel oil or other petroleum solvents to prevent "pickup" will not be permitted. Measures shall be taken to prevent oil, grease, or fuels from being dropped on the mat surface.

The rollers shall be capable of being reversed smoothly, without shoving or tearing the asphalt concrete, and there shall be no excessive lost motion in the steering mechanism.

C. Preparation of the Mineral Aggregate

1. Proportioning for Continuous and Batch Plants:

If blending of aggregates is required, separate bins or stockpiles shall be provided. Extreme care shall be exercised to keep these materials separated until they are delivered in their proper proportions onto the feeder leading to the dryer. Spreading or dumping filler, sand, or crushed rock over the tops of gravel pits, stockpiles, or in hoppers at the crushing plants will not be permitted.

The aggregates for the mixture shall be uniformly dried and heated to the mix temperature specified, without visible unburned fuel or carbon residue on the aggregate when discharged from the dryer. The mineral aggregate shall be screened into at least two (2) fractions dividing on the one-fourth (1/4) inch sieve, or other size agreed upon, and conveyed into separate compartments ready for proportioning and mixing. The hot elevator and screens shall be enclosed to prevent wind loss of fines.

Mineral filler shall be fed proportionately to the aggregate just prior to and during its introduction into the mixer and shall not pass through the gradation unit. Crushed rock screenings used as mineral filler shall be added separately to the cold feed into the dryer.

2. Cold-Feed Proportioning

The Contractor may elect to control aggregate proportioning at the cold feed in lieu of separation, storage, and recombination of the hot aggregate, contingent on the following requirements:

- a. Mineral aggregate shall be furnished for cold-feed proportions in at least two (2) general component aggregate sizes, coarse and fine aggregate. Coarse aggregate is defined as primarily the fraction on a No. 4 sieve. Fine aggregate is defined as primarily the fraction passing a No. 4 sieve.
- b. Component aggregate materials shall be stockpiled separately. Stockpiles of the component aggregate materials shall be maintained during mix production and the cold-feed mechanism charged uniformly from the stockpiles. Charging directly from pits, crusher, or screening plants will not be permitted.
- c. In batch-type mixing plants, the discharge shall be from one bin only into the center of the weight hopper. The amount of aggregate stored in the bin at any one time shall not exceed one batch in weight.
- d. It shall be the Contractor's responsibility to furnish component aggregate that, when combined the resulting gradation consistently meets specified gradation and job mix requirements. Failure to maintain production meeting these requirements will require immediate correction or suspension of the mode of control for aggregate proportioning.
- e. Each individual component required to make up the combined aggregate shall be fed on the conveyor into the dryer through a separate positive feed

control that can be easily and accurately calibrated. The feed shall be easily adjustable and shall maintain a constant and uniform flow throughout the range of its calibration.

D. Preparation of the Mixture:

Before delivery to the project, the aggregate shall be satisfactorily mixed with the asphalt at the central mixing plant. The amount of asphalt used will be in accordance with the job mix formula.

The mixing plant shall be operated using automatic controls. Manual operation will be permitted when automatic controls fail; however, the Contractor shall restore automatic operation within twenty-four (24) working hours.

The aggregates shall be combined in the plant in the proportionate amounts necessary to meet the required job mix formula. The asphalt shall be measured or gauged and introduced into the mixer in the proportionate amount and at the temperature established by the job mix formula. The temperature viscosity relationship of the asphalt furnished will be used as a guide for establishing the asphalt application temperature.

In batch plants, the mineral aggregate shall be mixed dry for a minimum of five (5) seconds, after which, hot asphalt shall be applied in a manner that will obtain uniform coating of particles.

After the required aggregate and asphalt have been introduced into the mixer, the materials shall be mixed until the aggregate is completely and uniformly coated and a thorough distribution of the asphalt throughout the aggregate is secured. The Contractor shall furnish the Engineer a wet mixing time for batch and continuous type plants for each type of aggregate used, as determined by a certified testing laboratory. Continuous mixing plants shall be operated at full, calibrated capacity. Throttling back to reduce production rate will not be permitted.

When hot mix storage bins are used, storage of the mix shall be limited to a maximum of thirty (30) hours.

E. Transportation and Delivery of the Mixture

The mixture shall be transported from the plant to the point of use in pneumatic-tired vehicles. The boxes of the vehicles shall be tight, clean, and smooth. Boxes shall be cleaned only with lime water, soap, or a detergent solution. Oil, diesel fuel, or other petroleum solvents shall not be used. No material shall be used which could adversely affect the asphalt concrete. Excess solution in the box shall be disposed of before the vehicle is loaded.

Operations between the times of sunset and sunrise shall be permitted only when approved by the Engineer.

When directed by the Engineer, each load shall be covered with a satisfactory tarpaulin.

F. Tacking, Spreading, and Compacting

The surface on which the asphalt concrete is to be placed, including all vertical contact faces, shall be tacked in accordance with Section 35, unless otherwise shown on the plans or directed by the Engineer. The tack coat shall be allowed a cure period, as determined by the Engineer, prior to asphalt concrete placement.

Asphalt concrete, shall be placed by self-propelled pavers. Handwork is permissible in inaccessible or odd-shaped areas.

A shoe attachment should be used to match the longitudinal joint(s) on the final paver pass(es) of the top lift unless otherwise directed by the Engineer.

The "temperature of mixture on delivery to the road (or construction site)" shall be the temperature of the mix just prior to placement.

Spot leveling and repair of the existing surface with asphalt concrete will be required in advance of the paver laid courses as designated by the Engineer. Potholes and areas of localized disintegration shall be cleaned of loose material, squared, tacked, leveled with asphalt concrete, and compacted by methods satisfactory to the Engineer. Spot leveling may be blade laid in lifts not exceeding three (3) inches of uncompacted depth. Compaction shall be by five (5) complete coverages as stated in the Specified Roller Coverage method, except a steel-face roller will not be required. Continuous and uniform operation shall be maintained. Trucks shall be available for continuous operation of the plant. Paver operation shall be uniform and consistent with the production at the plant. Stops and starts shall be restricted to a minimum.

Laydown operations shall proceed from the center to the shoulders of the roadbed surface. The center joints of succeeding lifts shall be offset approximately six (6) inches. The center joint of the top lift shall be located on centerline. Longitudinal joints other than at the lane lines will not be permitted in the top lift. In curb and gutter sections, laydown may proceed from the gutter line to the centerline when directed.

Transverse joints of the final lift shall be formed by cutting back, with a saw on the previous run, to expose the full depth of the course. When finished, the transverse joint of all lifts shall have a uniform texture and comply with the straight edge requirement. Waste material resulting from forming joints and temporary ramps shall be removed and disposed of.

Excessive pulling or segregation of the mix shall warrant suspension of operations.

Immediately after the mix has been placed and any surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling to the specified density requirements for the class of asphalt concrete designated. The in-place density shall

be determined by the use of a nuclear density testing machine. Test frequency shall be as specified in Section 31. J. herein.

Rollers shall be operated at a slow, uniform speed not to exceed five (5) miles per hour. Unless otherwise permitted by the Engineer, static steel-faced rollers shall be operated with the drive wheel nearest the paver. When abutting a previously laid lane and when breakdown rolling is being accomplished with a steel-faced roller, the longitudinal joint shall be rolled first by operating the roller on the finished lane with approximately six (6) inches of the roller projecting on the new lane.

The surface of each lift shall be free of waves and other irregularities. The surface of the final lift shall be checked with a ten (10) foot straight edge, furnished by the Contractor. The variation of the surface from the straight edge between any two (2) contact points shall not exceed two hundredth (0.02) foot. The crown, on all lifts, as indicated by checking with a ten (10) foot straight edge, shall be within four hundredth (0.04) foot of specified crown in any ten (10) foot length.

There shall be an attempt to correct irregularities before the temperature of the asphalt mix drops below 175 F. The longitudinal profile can be improved by using a grinder with diamond blades mounted on a horizontal shaft and other methods when approved by the Engineer. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground asphalt concrete. Grinding shall be day lighted to the outside edge of the pavement. Ground surfaces shall be flushed sealed. Under no circumstances shall operations continue when it becomes evident final rolling is not producing a smooth, uniform, compacted surface free from roller marks and other irregularities.

As a normal sequence, rolling shall be longitudinal, commencing at the outer edges of the mat and progressing toward the center in straight, parallel strips, overlapping at least six (6) inches.

Rollers shall proceed straight-forward and return in the same path. Turning the rollers to position them for the next pass shall occur at a point where the pavement temperature has cooled sufficiently to resist damage. The Contractor shall vary the points of reversal to prevent a transverse crease.

In order to prevent deformation, rollers shall not stand idle on any part of the mat, which has not been completed and cooled sufficiently to resist deformation.

The beveled edge shall be compacted by methods satisfactory to the Engineer during the breakdown or intermediate rolling.

The mix shall be compacted on the road by one of the following methods. Unless otherwise specified in the contract, the Specified Density Method shall be used.

1. Specified Density Method

The mix shall be compacted to the density specified for the class of asphalt concrete designated. The percent of density shall be based on the maximum specific gravity of the test specimens prepared in the field in accordance with SD 312. The compacted density of the asphalt concrete shall be as determined by SD 311.

Compaction of mix placed on entrances to residences or businesses and intersecting road approaches shall be compacted by the Specified Roller Coverage Method.

Density of asphalt concrete in place shall be in accordance with SD 311. Rolling shall be completed before the temperature of the in-place mix drops below one hundred and eighty (180) degrees.

2. Specified Roller Coverages

The mix shall be compacted by at least four (4) complete coverages with pneumatic-tired rollers and at least one (1) complete coverage with steel faced rollers.

Breakdown rolling may be accomplished by steel-faced rollers when approved by the Engineer.

Self-propelled pneumatic-tired rollers shall cover an overall surface width of at least sixty (60) inches and furnish a minimum rolling pressure of two hundred fifty (250) pounds per inch of roller width.

Self-propelled, tandem, smooth steel rollers (two [2] steel drums operating in the same track) shall furnish a minimum rolling pressure of two hundred seventy-five (275) pounds per inch of roller width.

Rolling shall proceed on the mat as soon as laydown is completed. Completion of rolling on any segment shall not lag behind the laydown more than one thousand (1000) feet. During periods of cool weather, this maximum distance between laydown and final rolling shall be reduced as directed by the Engineer. Compaction to a specified density will not be required; however, additional roller coverages may be required in order to obtain a smooth surface finish.

When directed, the Contractor shall cool, saw, and remove an undamaged six (6) inch square sample or a seven (7) inch diameter round sample from an area designated and repair the hole to the satisfaction of the Engineer.

Rolling between the times of sunset and sunrise shall be permitted only when approved by the Engineer.

G. Asphalt Patching

Asphalt replacement for utility storm sewer or similar work shall comply with the requirements herein and as follows:

1. Minimum Patch Depth

Unless specified otherwise, all permanent asphalt patches shall be placed to a minimum depth of five (5) inches. Should existing pavement depths be greater than five (5) inches, the permanent patch shall match the depth of the existing pavement or as directed by the Engineer.

2. Minimum Patch Width

Minimum patch width shall be six feet or the initial saw width for the proposed trench width plus two feet (one foot on each side of the initial saw cut), whichever is greater. (See Section 41)

All mainline, permanent patches equal to or greater than eight feet in width and longer than 40 feet shall be placed with a paving machine. The use of Layton pavers is prohibited.

3. Surface Tolerance

The patch surface shall be tested with a ten foot straightedge. The maximum permissible surface deviation shall be one-quarter inch in ten feet. The measurements will be made parallel to traffic and up to within one foot of the edge of the existing pavement. Deviation within one foot of the existing pavement shall be no greater than that measured on the adjacent existing pavement.

Areas that exceed the permissible deviation shall be subject to corrective action as directed by the Engineer.

Any corrective measures shall produce a structurally sound, smooth riding surface.

4. Concrete streets with asphalt overlays shall be replaced as described in Section 40. Asphalt overlay thickness shall match existing thickness and shall extend at least six (6) inches beyond edges formed by new and existing concrete paving.

The asphalt shall be tapered at a maximum 10:1 slope longitudinally on each side of any drainage pans and on any areas of existing streets where the overlay begins or ends.

The edges of the new asphalt overlay patch shall be tapered to meet the gutter lip as indicated on the standard detail sheet in the plans.

Under certain conditions where localized ponding problems exist on the existing pavement, the Engineer may require the Contractor to overlay all the way to the face of the curb.

5. If hot-mix asphalt will not be available for a significant period, the Contractor shall place a temporary cold mix patch or overlay as directed by the Engineer.

The Engineer shall determine if placement of the cold mix is necessary. The cold mix shall conform to Section 39.

When hot-mix asphalt becomes available, the Engineer will issue written notice to the Contractor to begin placing the pavement asphalt within ten (10) working days of receiving the notice.

6. Measurement and payment for the asphalt patching shall be in accordance with the section pertaining to the class of asphalt concrete being bid.

Measurement and payment for cold mix shall be in accordance with Section 39, COLD MIX ASPHALT.

H. Maintenance

The Contractor shall be responsible for the maintenance of the work during construction and until final acceptance. Maintenance shall include protection and repair of the prepared base course, tack coat, wearing surface mat, shoulders, and seal course. Rich or bleeding areas, breaks, raveled spots, or other nonconforming areas in the wearing surface or base shall be corrected during such maintenance period.

I. Traffic Control

Allowing traffic to travel over the roadway will not be permitted until the surface has been thoroughly compacted and cooled sufficiently to resist marking or distortion.

Where traffic is to be maintained by means of part-width construction, the Contractor shall control traffic by the use of identified flaggers. The Contractor shall schedule work so traffic will not be inconvenienced by long one-way lanes.

J. Density Tests/Frequency

The Contractor shall submit the following test data for each class of asphalt concrete:

One (1) Standard Density at the start of work and each time the mix or source of material is changed;

One (1) in-place, non-destructive (nuclear gauge) density test per day per 200 ton lot of mainline paving mix;

One (1) in-place, non-destructive (nuclear gauge) density test per day per 250 square yards of patching.

These tests will not be paid for directly, but shall be understood to be subsidiary work pertaining to the several classes of asphalt concrete, except when there is a bid item for asphalt compaction testing, per each test included in the Bidder's Proposal or as otherwise specified in the detailed specifications.

In addition to this testing, the Contractor may be required to remove and test in-place asphalt concrete to determine field densities by sawing or coring samples from areas to be determined by the Engineer.

These field asphalt core density tests will be measured in accordance with Section 31.4C - Compaction Samples and paid for in accordance with Section 31.5C.

All sampling and testing shall be done by certified testing laboratory personnel, and all test results shall be submitted to the Engineer.

Failing density tests shall result in an adjustment of the warranty period and the contract unit price in accordance with the following table for all classes of asphalt concrete:

Amount of Deviation:	0% to -1%	-1% to -2%	-2% to -3%	-3% to -4%
Amount of Deduction:	0% to 5%	5% to 10%	10% to 20%	20% to 30%
Additional Warranty Period:	1 year	2 years	3 years	4 years

Note: The amount of deviation shall be the difference between the specified density and the average of all densities for that class of asphalt concrete if this average is less than the specified density.

The City reserves the right to order additional tests. The Contractor shall pay for those additional tests that fail to meet specified density, and the City will pay for those additional tests that do meet the specified density.

The Engineer or his representative shall be present for all field sampling and lab testing performed for the Contractor. Failure to notify the City of pending sampling or testing could result in rejection of submitted data and re-testing by in-place methods.

All required data shall be received by the Engineer before payment for pavement exceeds seventy-five percent (75%) of the total quantity.

31.4 METHOD OF MEASUREMENT

A. Asphalt Concrete Mat for Incidental Paving

Asphalt Concrete Mat for Incidental Paving will be measured to the nearest one-tenth (0.1) ton. The mixture of mineral aggregate and asphalt for mat will be weighed after mixing, and no deduction will be made for the weight of the asphalt included in the mixture.

B. Asphalt Concrete, Various Classes

Asphalt Concrete, Various Classes will be measured to the nearest one-tenth (0.1) ton, material weight. The mixture of mineral aggregate and asphalt for mat will be weighed after mixing, and no deduction will be made for the weight of the asphalt included in the mixture.

Deduction will not be made for material removed from temporary approaches.

C. Compaction Samples

The measurement of core samples will be by actual count of those samples ordered and accepted by the Engineer for testing purposes.

31.5 BASIS OF PAYMENT

- A. The accepted quantities of asphalt concrete mat for incidental paving will be paid for at the contract price per ton, complete, in place, subject to deductions noted herein. Contractor shall provide Engineer with valid weigh tickets for asphalt concrete mat, furnished and installed. If there is no bid item for asphalt concrete mat, the price for such shall be included in and paid for as Asphalt Concrete, Various Classes. Weigh tickets shall be delivered to the Engineer within 48 hours of placement. Tickets delivered after 48 hours will not be valid and will not be paid.

B. Asphalt Concrete, Various Classes

The accepted quantities of Asphalt Concrete, Various Classes, will be paid for at the contract price per ton, complete, in place, subject to deductions noted herein. Contractor shall provide Engineer with valid weigh tickets for asphalt concrete, furnished and installed. Weigh tickets shall be delivered to the Engineer within 48 hours of placement. Tickets delivered after 48 hours will not be valid and will not be paid for.

C. Compaction core samples, where required, will be paid for at the contract price per each.

END OF SECTION

SECTION 32

ASPHALT CONCRETE - CLASS E

32.1 DESCRIPTION

A. General:

This work consists of constructing one or more courses of asphalt concrete on a prepared surface.

B. Related Work:

- Section 31 - Asphalt Concrete - General
- Section 33 - Asphalt Concrete - Class G
- Section 34 - Asphalt Concrete - Class S
- Section 35 - Prime, Tack, and Flush Seal Coats
- Section 37 - Asphalt Surface Treatment
- Section 39 - Cold Mix Asphalt Concrete
- Section 115 - Aggregates for Asphalt Concrete
- Section 116 - Aggregate for Asphalt Surface Treatments
- Section 118 - Asphalt Material

32.2 MATERIALS

The materials and their use shall conform to the requirements of Section 31, Asphalt Concrete – General, with the following modifications:

The job mix shall fix a single percentage of aggregate passing each required sieve size, a single percentage of asphalt to be added to the aggregate, a single asphalt application temperature, a single temperature at which the mixture is to be emptied from the mixer, and a single temperature at which the mixture is to be delivered on the road.

The following table sets forth the tolerances for the job-mix formula:

3/8 inch	± 7%
No. 4, No. 10, No. 40	± 5%
No. 200	± 2.0%
Asphalt Content.....	± 0.3%
Temp. of mixture when emptied from mixer.....	± 20° F.
Temp. of mixture on delivery to the road.....	+ 30° & -20° F.
Asphalt application temp.....	± 20° F.

32.3 CONSTRUCTION REQUIREMENTS

The construction requirements shall be as prescribed in Section 31, Asphalt Concrete – General, with the following modifications:

- A. The compacted thickness of each lift shall not exceed three (3) inches, unless modified by the Detailed Specifications.

- B. The minimum density requirement for polymer modified asphalt mix (such as PG64-28, PG70-24, and PG70-28) and non-polymer modified asphalt mix (such as PG64-22, PG58-28, and all older style penetration graded oils shall be ninety two percent (92%) of maximum density (Rice method) for all mainline applications and shall be ninety one percent (91%) of maximum density (Rice method) for all narrow alleyways, walkways, parking lots, and similar work where a majority of the placement work is hand work and is not subject to the specified Roller Coverage method or otherwise modified in the Detailed Specifications.

32.4 METHOD OF MEASUREMENT

Measurement will be as prescribed, in Section 31, Asphalt Concrete – General.

32.5 BASIS OF PAYMENT

Payment will be as prescribed, in Section 31, Asphalt Concrete – General.

END OF SECTION

SECTION 33

ASPHALT CONCRETE - CLASS G

33.1 DESCRIPTION

A. General:

This work consists of constructing one or more courses of asphalt concrete on a prepared surface.

B. Related Work:

- Section 31 - Asphalt Concrete - General
- Section 32 - Asphalt Concrete - Class E
- Section 34 - Asphalt Concrete - Class S
- Section 35 - Prime, Tack, and Flush Seal Coats
- Section 37 - Asphalt Surface Treatment
- Section 39 - Cold Mix Asphalt Concrete
- Section 115 - Aggregates for Asphalt Concrete
- Section 116 - Aggregates for Asphalt Surface Treatments
- Section 118 - Asphalt Material

33.2 MATERIALS

The materials and their use shall conform to the requirements of Section 31.2, ASPHALT CONCRETE - GENERAL, with the following modifications:

The job mix shall fix a single percent of aggregate passing each required sieve size, a single percentage of asphalt to be added to the aggregate, a single asphalt application temperature, a single temperature at which the mixture is to be emptied from the mixer, and a single temperature at which the mixture is to be delivered on the road.

The following table sets forth the tolerances for the job mix formula:

3/8 inch	± 7%
No. 4, No.10, No. 40	± 5%
No. 200	± 2.0%
Asphalt Content.....	± 0.3%
Temp. of mixture when emptied from mixer.....	± 20° F.
Temp. of mixture on delivery to the road.....	+ 30° & -20° F.
Asphalt application temp.....	± 20° F.

33.3 CONSTRUCTION REQUIREMENTS

The construction requirements shall be as prescribed in Section 31, Asphalt Concrete – General, with the following modifications:

- A. The compacted thickness of each lift of Type 1 shall not exceed three (3) inches, and the compacted thickness of each lift of Type 2 shall not exceed two (2) inches, unless modified by the Detailed Specifications.
- B. The minimum density requirement for polymer modified asphalt mix (such as PG64-28, PG70-24, and PG70-28) and non-polymer modified asphalt mix (such as PG64-22, PG58-28, and all older style penetration grade oils) shall be ninety two percent (92%) of maximum density (Rice method) for all mainline applications and shall be ninety one percent (91%) of maximum density (Rice method) for all narrow alleyways, walkways, parking lots, and similar work where a majority of the placement work is hand work and is not subject to the specified Roller Coverage method or otherwise modified in the detailed specifications.

33.4 METHOD OF MEASUREMENT

Measurement will be as prescribed, in Section 31, Asphalt Concrete – General.

33.5 BASIS OF PAYMENT

Payment will be as prescribed, in Section 31, Asphalt Concrete – General.

END OF SECTION

SECTION 34

ASPHALT CONCRETE - CLASS S

34.1 DESCRIPTION

A. General

This work consists of constructing a course of asphalt concrete on a prepared surface.

B. Related Work

- Section 31 - Asphalt Concrete - General
- Section 32 - Asphalt Concrete - Class E
- Section 33 - Asphalt Concrete - Class G
- Section 35 - Prime, Tack, and Flush Seal Coats
- Section 37 - Asphalt Surface Treatment
- Section 39 - Cold Mix Asphalt Concrete
- Section 115 - Aggregates for Asphalt Concrete
- Section 116 - Aggregates for Asphalt Surface Treatments
- Section 118 - Asphalt Material

34.2 MATERIALS

The materials and their use shall conform to the requirements of Section 31, Asphalt Concrete – General, with the following modifications:

The job mix shall fix a single percentage of asphalt to be added to the aggregate, a single asphalt application temperature, a single temperature at which the mixture is to be emptied from the mixer, and a single temperature at which the mixture is to be delivered on the road.

The following table sets forth the tolerances for the job mix formula:

Asphalt Content.....	± 0.3%
Temp. of mixture when emptied from mixer.....	± 20° F.
Temp. of mixture on delivery to the road.....	+ 30° & -20° F.
Asphalt application temperature.....	± 20° F.

34.3 CONSTRUCTION REQUIREMENTS

The construction requirements shall be as prescribed in Section 31, Asphalt Concrete – General, with the following modifications:

- A. Construction will be permitted only between June 1 and September 15, inclusive, and when the air and surface temperature are sixty degrees Fahrenheit (60° F.) in the shade.
- B. Laydown widths shall correspond with the lane widths as shown on the typical sections.
- C. Substitute the following for the first two paragraphs of Section 31.3.B.6 Rollers:

The self-propelled, tandem, smooth-steel rollers (two [2] steel drums operating in the same track) shall furnish a minimum of two hundred seventy-five (275) pounds pressure per lineal inch of rolling width. Pneumatic-tired rollers are not required. Vibrating rollers are not permitted.

- D. Breakdown rolling, consisting of a minimum of two (2) complete coverages with steel-faced rollers, shall proceed on the mat as soon as laydown is completed. Operations shall be so scheduled that breakdown rolling is completed on a segment within three hundred (300) feet of the letdown.

Final or finish rolling shall consist of a minimum of, one (1) complete coverage with steel-faced roller. Completion of rolling shall not lag behind the lay down by a distance of more than six hundred (600) feet.

34.4 METHOD OF MEASUREMENT

Measurement will be as prescribed in Section 31, Asphalt Concrete – General.

34.5 BASIS OF PAYMENT

Payment will be as prescribed in Section 31, Asphalt Concrete – General.

END OF SECTION

SECTION 35

PRIME, TACK, AND FLUSH SEAL COATS

35.1 DESCRIPTION

A. General:

This work consists of preparing and treating a prepared surface with asphalt material and sand as required.

B. Related Work:

Section 31 - Asphalt Concrete - General
Section 32 - Asphalt Concrete - Class E
Section 33 - Asphalt Concrete - Class G
Section 34 - Asphalt Concrete - Class S
Section 39 - Cold Mix Asphalt Concrete
Section 116 - Aggregates for Asphalt Surface Treatments
Section 118 - Asphalt Material

35.2 MATERIALS

A. Asphalt:

Asphalt of the type specified on the plans shall conform to the requirements of Section 118.

35.3 CONSTRUCTION REQUIREMENTS:

A. Weather and Seasonal Requirements:

1. Tack Coat:

The application of a tack coat will be permitted only:

- a. When air and surface temperature on the project are both at least thirty-five degrees Fahrenheit (35° F.) in the shade.
- b. When conditions are dry, except emulsified asphalt may be applied when the surface is slightly damp.

C. During daylight hours.

- d. When the wind does not adversely affect the spraying operation.

2. Prime Coat:

The application of a prime coat will be permitted only:

- a. When the air and surface temperatures on the project are both at least sixty degrees Fahrenheit (60° F.) in the shade. The temperature requirement may be waived by the Engineer.
- b. When conditions are dry.
- c. During daylight hours.
- d. When wind does not adversely affect the spraying operation.

3. Flush Seal Coat:

The application of a flush seal coat will be permitted only:

- a. When air and surface temperatures on the project are both at least fifty degrees Fahrenheit (50° F.) in the shade.
- b. When the surface is dry or slightly damp.
- c. When the wind does not adversely affect the spraying operations.
- d. During daylight hours.

B. Dilution of Emulsified Asphalt:

Emulsified asphalt shall be diluted and uniformly mixed, prior to application, by adding potable water in the distributor and, if necessary, agitating the mixture. The rate of dilution shall be as directed by the Engineer to fit weather and road surface conditions.

The temperature of the emulsified asphalt and water at the time of dilution shall be sufficient to prevent adverse effects on the mixture and to facilitate mixing.

C. Equipment:

The following minimum equipment or its equivalent as determined by the Engineer shall be furnished by the Contractor:

1. A rotary broom with water distribution capability or a vacuum sweeper to remove material with minimal fugitive dust emissions.

2. Equipment for heating the asphalt material in or at the tank car, transport truck or distributor shall be designed and constructed to heat the material without burning, scorching, or overheating, and with positive control of the heat. The introduction of live steam directly into the material will not be permitted.
3. Distributors used in applying the asphalt material shall be self-propelled, equipped with pressure-type mechanical circulating pumps and valves, a heating system and insulated tank that will provide the uniform required temperature throughout the entire contents of the distributor tank. Detachable distributor units separate from the tank will not be allowed.

The distributor shall be designed and constructed to apply the heated asphalt material to the road surface in accurately measured quantities and maintain the specified rate uniformly during the distribution of the entire tank load, regardless of change in gradient, superelevation, direction, or content level in the tank. Calibration runs for verification shall be made at the start of the work, as required by the Engineer.

The spray nozzles shall be designed, sized, and arranged to insure uniform distribution of heated asphalt material at the designated quantities, in an overlapping fan-shaped spray without surge, streaks, ridges, or bare spots. A strainer shall be provided in the discharge line, if required, to prevent nozzles from clogging. The output of each nozzle on the bar shall be the same, and a test shall be made, if required, in advance of use to determine compliance with this requirement. Different sizes, heights, pressures, and settings of nozzles for different designated rates shall be furnished and installed by the Contractor, as required by the Engineer.

The distributor shall be equipped with a tachometer clearly visible to the operator, which will accurately show the speed in feet per minute.

Pressure metering distributors shall be furnished with an accurate pressure gauge showing the distribution pressure. Volume metering distributors shall be furnished with a pump tachometer or volume meter showing the volume furnished. The required equipment for the distributor shall also include an accurate mercury-actuated thermometer showing the temperature of the material in the tank and a contents gauge showing the number of gallons in the tank at any content level.

The distributor shall be equipped with adjustable spray bars so arranged that application width will be available in two (2) foot intervals from four (4) feet to at least sixteen (16) feet.

The distributor spray bars shall be capable of operating at a constant controlled height and shall be of the full circulating type. Each nozzle of the distributor bar shall be equipped with a cutoff valve, which stops the flow immediately without dripping. Compliance with these requirements must be proven before the distributor can be used.

D. Surface Preparation:

Surfaces to receive tack and flush seal coats shall be lightly sprinkled with water, if necessary, to prevent excessive fugitive dust emissions, and thoroughly swept with a rotary broom and cleaned of all loose and adhering foreign material. Surfaces to receive a prime coat shall be satisfactorily compacted and cured and, if necessary, lightly sprinkled with water to prevent excessive fugitive dust emissions. Operations shall be in accordance with applicable dust permits.

E. Application of Asphalt:

Adjacent appurtenances shall be protected from the splatter of asphalt. The Engineer will specify the temperature range within which the asphalt shall be maintained at the time of application. Asphalt shall be applied by means of a pressure distributor in a uniform and continuous manner. Specified rates shall be applied unless otherwise ordered by the Engineer.

Unauthorized increases in rates will not be eligible for payment.

The angle of the spray nozzles and the height of the spray bar shall be set to obtain uniform distribution. The distributor shall be traveling at the proper speed when the spray bar is opened. The edges of the spread shall not appreciably overlap. Areas inaccessible to the distributor shall be covered by hand-spray methods. When the distributor is not in operation, it shall be parked off the roadbed or drip pans shall be placed under the spray bar.

Tack shall be applied when the mat has become dirty, or when the mat has been uncovered for more than 24 hours, or when directed by the Engineer.

Tack application ahead of mat laydown shall be limited by job conditions and be subject to approval by the Engineer. Tack application ahead of mat lay down shall not exceed the amount estimated for one day's operation.

Tacked areas, which are unsatisfactory, shall be retacked. Required retacking, which is not the fault of the Contractor will be paid for at the contract unit price for tack asphalt.

F. Traffic Control:

The Contractor shall provide proper flaggers, signs, and barriers to warn, direct, and prevent traffic from getting onto the freshly applied asphalt until it has penetrated or hardened suitably.

35.4 METHOD OF MEASUREMENT**A. Prime Coat:**

Prime coat will be measured to the nearest gallon of asphalt material. Contractor shall provide Engineer with valid quantity tickets for prime coat, furnished and installed, showing gross, tare and net weights, project, truck, time, and initials of scale operator. Weighing shall be done on a SDDOT certified scale.

B. Tack Coat:

Tack coat will be measured to the nearest gallon of asphalt material. Contractor shall provide Engineer with valid quantity tickets for tack coat, furnished and installed, showing gross, tare, and net weight, project, truck, time, and initials of scale operator. Weighing shall be done on a SDDOT certified scale.

C. Flush Seal:

Flush seal will be measured to the nearest square yard of asphalt material.

35.5 BASIS OF PAYMENT**A. Prime Coat:**

The accepted quantities of prime coat will be paid for at the contract price per gallon of asphalt material complete in place as computed from valid weigh tickets. Tickets received after forty-eight hours will not be considered valid.

B. Tack Coat:

The accepted quantities of tack coat will be paid for at the contract price per gallon of asphalt material complete in place as computed from valid weigh tickets. Tickets received after forty-eight hours will not be considered valid.

C. Flush Seal:

The accepted quantities of flush seal will be paid for at the contract price per square yard to the nearest square yard complete in place.

END OF SECTION

SECTION 36

COLD PAVEMENT PLANING

36.1 DESCRIPTION

A. General:

This work consists of removing a portion of the existing asphalt surface course and stockpiling the removed material at specified locations.

B. Related Work:

Section 15 - Disposal of Surplus Excavation and Waste
Section 35 - Prime, Tack, and Flush Seal Coats

36.2 MATERIALS (Not specified)

36.3 CONSTRUCTION REQUIREMENTS

A. General:

The material shall be removed by cold pavement planing with the specified equipment, without the use of heat.

B. Equipment:

The equipment for cold planing shall consist of a rotating drum equipped with teeth capable of removing material to a minimum depth of three (3) inches in one (1) pass and producing a smooth surface finish. The cold planing machine shall be capable of automatically establishing a longitudinal profile grade within plus or minus one-eighth ($\pm 1/8$) inch, referencing from the existing gutter, pavement, and/or an erected fixed string line and shall be controlled by an automatic system for controlling grade.

The drum shall be capable of tilting to allow feathering of edges to zero cut.

C. Construction Methods:

1. The existing surface of the pavement shall be removed by planing at the depth, width, cross-section, and grade shown on the plans or established by the Engineer.

The resulting pavement surface shall be free of detrimental ridges or grooves.

2. Loose material resulting from the planing shall be immediately picked up and hauled to the specified stockpile sites or disposed of as directed by the Engineer. Prior to allowing traffic on the planed surface, the surface shall be thoroughly vacuumed or wet broomed free of any remaining loose material. It may be necessary to lightly water the planed area prior to brooming to minimize air-borne dust.

36.4 METHOD OF MEASUREMENT

Plans quantity will be the basis of measurement used unless, changes are ordered by the Engineer. If additional areas are ordered planed from the plan-shown areas or areas designated for planing are deleted, these areas will be measured and the plan quantity appropriately adjusted.

36.5 BASIS OF PAYMENT

Pavement planing will be paid for at the contract unit price per square yard of pavement surface planed.

END OF SECTION

SECTION 37

ASPHALT SURFACE TREATMENT

37.1 MATERIALS

A. General:

This work consists of an application of asphalt covered with a spread of cover aggregate.

B. Related Work:

Section 35 – Prime, Tack, and Flush Seal Coats
Section 116 - Aggregates for Asphalt Surface Treatment
Section 118 - Asphalt Material

37.2 MATERIALS

A. Asphalt:

Asphalt of the type and grade shown on the plans shall conform to the requirements of Section 118 and the following additional requirements:

When tested in accordance with SD 305 using Standard Aggregate (Sioux Falls Quartzite, from the Sioux Falls, South Dakota area), the asphalt shall conform to the following requirements;

Coating Obtained, Min.....95% Aggregate Surface Coated
Coating Retained, Min.....85% Aggregate Surface Coated

This specification requirement (SD 305) will be applicable only to cutback asphalt (Rapid Curing Type).

B. Cover Aggregate:

Cover aggregate of the type specified shall conform to the requirements of Section 116.

37.3 CONSTRUCTION REQUIREMENTS**A. Weather and Seasonal Requirements:**

The application of surface treatments will be permitted only during daylight hours when conditions are dry and when it does not adversely affect the spraying operation.

Minimum temperatures and seasonal limitations are as follows:

COVER AGGREGATE	AIR AND SURFACE TEMP. (IN THE SHADE)	SEASONAL LIMITATIONS (DATES ARE INCLUSIVE)
Type 1	70 degrees F.	June 1 - October 1
Type 2	70 degrees F.	June 1 - October 1
Type 3A	60 degrees F.	June 1 - October 1
Type 3A	70 degrees F.	Sept. 1 - October 1
Type 3B	50 degrees F.	May 1 - December 1

B. Equipment:

The following minimum equipment shall be furnished in good condition by the Contractor:

1. A vacuum, power broom.
2. Equipment for heating and applying the asphalt shall conform to the requirements of Section 35.
3. A self-propelled aggregate spreader, with positive controls capable of depositing the required amount of aggregate uniformly over the full width of the asphalt application. When spreading Type 2 cover aggregate, the spreader shall be equipped with means of applying the larger aggregate to the surface ahead of the smaller aggregate. A tailgate spreader of the type approved by the Engineer may be substituted for the above-described spreader when applying Type 3B cover aggregate.
4. The rollers shall completely cover an overall surface width of at least sixty (60) inches and furnish a minimum uniform rolling pressure of two hundred fifty (250) pounds per inch of rolling width.

C. Surface Preparation:

The surface to be treated shall be thoroughly swept with a vacuum power broom and cleaned of all loose and adhering foreign material. Appurtenances immediately adjacent to the surface to be treated shall be protected from the splatter of asphalt. Freshly primed bases shall be cured prior to the application of surface treatments.

D. Application of Asphalt:

Adjacent appurtenances shall be protected from the splatter of asphalt. The Engineer will specify the temperature range within which the asphalt shall be maintained at the time of application. Asphalt shall be applied by means of a pressure distributor in a uniform and continuous manner. Specified rates shall be applied unless otherwise ordered by the Engineer. Unauthorized increases in rates will not be eligible for payment.

The angle of the spray nozzles and the height of the spray bar shall be set to obtain uniform distribution. A strip of building paper, at least three (3) feet in width and with a length equal to that of the spray bar plus one (1) foot, shall be used at the beginning of each spread. The distributor shall be traveling at the proper speed when the spray bar is opened. Skipped areas and deficiencies shall be corrected as soon as they are discovered. The edges of the spread shall not appreciably overlap. Areas inaccessible to the distributor shall be satisfactorily covered by hand spray methods.

Under no circumstances shall spraying operations proceed when it is evident the asphalt spread will not be covered with aggregate and rolled all in accordance with the prescribed schedule contained in the following sections.

E. Application of Cover Aggregate:

Cover aggregate shall be spread immediately following application of the asphalt. Under calm wind conditions, approximately five (5) miles per hour or less, the spread of cover aggregate shall follow within eight (8) minutes of the application of the asphalt. When the wind velocities are greater, the maximum time between applications of asphalt and cover aggregate shall be reduced as determined by the Engineer.

The spreading of cover aggregate following the application of "High Float" Emulsified Asphalt may be adjusted by the Engineer from the time limitations as shown above to fit project conditions.

The Contractor shall protect the treated surface from damage by traffic by continually maintaining a complete aggregate coverage, except that a strip of asphalt application approximately (4) four inches wide along that side of the spread forming a longitudinal joint with the adjacent spread shall be left uncovered. The adjacent asphalt and cover aggregate application shall overlap this strip. In lieu of this procedure, a butt joint may be constructed using special end nozzles.

Longitudinal joints, other than at centerline, will not be permitted within the center twenty-four (24) feet.

The cover aggregate shall be loaded in trucks to minimize segregation, eliminate oversize, and effectively break up or discard material bonded into chunks. When required, aggregate shall be uniformly moistened before or during loading.

Specified rates shall be applied unless otherwise ordered by the Engineer. Unauthorized increases in rates will not be eligible for payment.

Prior to rolling operations, the Engineer may order the Contractor to adjust inequalities in the spread of Type 3 cover aggregate by means of a drag broom.

F. Rolling Operations:

Rolling shall begin immediately behind the spreader and shall consist of four (4) complete coverages using pneumatic tired rollers. Operations shall be scheduled to complete the rolling within forty (40) minutes after the cover aggregate is applied. Rollers shall not be operated at a speed in excess of five (5) miles per hour. The weight and tire pressures of the rollers shall be varied as directed by the Engineer to obtain the most satisfactory embedment of the cover material without undue crushing of the aggregate. Turning of rollers on the freshly treated surface is prohibited. Rolling at night or when light conditions would create a traffic hazard will not be allowed.

Alternate rolling procedures that provide complete roller coverage directly behind the aggregate spread and completion of the four (4) complete roller coverages within the maximum time of forty (40) minutes may be used if approved by the Engineer.

G. Traffic Control:

Construction operations shall be coordinated to result in the least delay of traffic. If traffic is permitted, it shall be controlled by flaggers or pilot car, during application of the surface treatment on driving lanes. The traffic shall not exceed twenty (20) miles per hour for a period of four (4) hours after application. The minimum four (4) hour traffic control period may be reduced if ordered by the Engineer.

The width, arrangement, and sequence of the parallel application strips shall be governed so as not to unduly inconvenience traffic.

H. Maintenance and Repair:

Areas of the surface treatment, which may peel or otherwise be unsatisfactory for any reason shall be repaired with additional asphalt, cover aggregate, and rolling. Additional compensation for repair due to causes not the fault of the Contractor will be paid at the contract unit price for asphalt surface treatment.

The finished surface of the surface treatment shall be smooth riding and of uniform color. Lack of uniformity such as transverse or horizontal ridges, raveled spots, wheel marks, depressions, abrupt color changes, and other inequalities shall be corrected by the Contractor, as ordered by the Engineer. Payment will not be made for this correction work.

Special attention shall be given to the transverse and longitudinal joints during the process of the rolling work in order to insure a uniform appearance and smooth riding surface. The Contractor shall smooth and correct the appearance of these joints, as ordered by the Engineer, without additional compensation.

Any splatter of asphalt on roadway appurtenances, shall be satisfactorily cleaned off by the Contractor.

The loose material left on the surface shall be lightly vacuumed off three (3) to five (5) days after sealing the road.

Vacuumed-off material shall be removed and disposed of by the Contractor without additional compensation.

37.4 METHOD OF MEASUREMENT

A. Asphalt for Surface Treatment:

Asphalt for surface treatment will be measured to the nearest one-tenth (0.1) ton. Contractor shall provide Engineer with valid weigh tickets for asphalt, furnished and installed.

B. Cover Aggregate:

Cover aggregate will be measured to the nearest one-tenth (0.1) ton. Contractor shall provide Engineer with valid weigh tickets for cover aggregate, furnished and installed.

37.5 BASIS OF PAYMENT

A. Asphalt for Surface Treatment:

The accepted quantities of asphalt for surface treatment will be paid for at the contract price per ton, complete, in place. Weigh tickets will not be considered valid if received more than forty-eight hours after placement.

B. Cover Aggregate:

The accepted quantities of cover aggregate of the type specified will be paid for at the contract price per ton, complete, in place. Weigh tickets will not be considered valid if received more than forty-eight hours after placement.

END OF SECTION

SECTION 39

COLD MIX ASPHALT CONCRETE

39.1 DESCRIPTION

A. General:

This work consists of furnishing and placing a temporary course of cold mix asphalt concrete on a prepared surface.

B. Related Work:

Section 35 - Prime, Tack, and Flush Seal Coats
 Section 115 - Aggregates for Asphalt Concrete
 Section 118 - Asphalt Mat

39.2 MATERIALS

A. Aggregate:

The aggregate shall conform to the requirements of the following table:

Passing 1/2 in sieve	100%
Passing No. 4 sieve.....	80%
Passing No. 8 sieve.....	40-60%
Passing No. 40 sieve.....	15-32%
Passing No. 200 sieve.....	4-12%

One hundred percent (100%) of the aggregate retained on the Number 4 or larger sieve shall have two (2) or more fractured faces.

B. Asphalt:

The asphalt material shall be MC-250. When limestone rock is used, the asphalt content shall be four and one-half percent (4 1/2%) to five percent (5%). When river rock is used, the asphalt content shall be five and one-half percent (5 1/2%) to six percent (6%).

39.3 CONSTRUCTION REQUIREMENTS

The cold mix shall be placed at the locations and depths specified on the plans, in the detailed specifications, and/or as directed by the Engineer.

The Contractor will be responsible for satisfactorily maintaining the cold mix until the permanent patch is placed. Should any maintenance work be required on any cold mix, the Contractor shall do so within forty-eight (48) hours of receiving notice from the Engineer. If the Contractor does not accomplish the necessary work within forty-eight (48) hours, the City will have the work done and will charge the Contractor one and one-half (1 1/2) times the cost incurred.

39.4 METHOD OF MEASUREMENT

Measurement will be as prescribed in Section 31, Asphalt Concrete – General.

39.5 BASIS OF PAYMENT

Payment will be as prescribed in Section 31, Asphalt Concrete – General.

END OF SECTION

SECTION 40

PORTLAND CEMENT CONCRETE PAVEMENT

40.1 DESCRIPTION

A. General:

This work consists of constructing Portland Cement Concrete Pavement with or without reinforcement on a prepared surface.

B. Related Work:

Section 100 - Portland Cement
Section 101 - Air-Entraining Admixtures
Section 102 - Chemical Admixtures for Concrete
Section 104 - Water for Use in Portland Cement Concrete
Section 105 - Fine Aggregate for Use in Portland Cement Concrete
Section 107 - Coarse Aggregate for Use in Portland Cement Concrete
Section 108 - Concrete Curing Materials
Section 113 - Preformed Expansion Joint Filler for Concrete
Section 114 - Concrete Joint Sealer
Section 123 - Reinforcement

40.2 MATERIALS

A. Cement:

Cement shall conform to the requirements of Section 100. Type II cement shall be used for all concrete pavement.

B. Admixtures:

Admixtures shall conform to the requirements of Sections 101 and 102.

C. Water:

Water shall conform to the requirements of Section 104.

D. Fine Aggregate:

Fine aggregate shall conform to the requirements of Section 105.

E. Coarse Aggregate

Coarse aggregate shall conform to the requirements of Section 107.

F. Reinforcing Steel:

Reinforcing steel shall conform to the requirements of Section 123.

G. Joint Filler:

Joint filler shall conform to the requirements of Section 113.

H. Joint Sealer:

Joint sealer shall conform to the requirements of Section 114.

I. Backer Rod:

Backer Rod shall conform to the requirements of Section 114.

J. Curing Materials:

Curing materials shall conform to the requirements of Section 108, white pigmented Linseed Oil Base Emulsion Compound.

40.3 CONSTRUCTION REQUIREMENTS

A. Quality of Concrete, Proportioning and Mix Design:

When the Contractor proposes to use materials for Portland Cement Concrete pavement from sources not previously accepted by the City, the Contractor shall obtain independent, certified laboratory tests that verify that the materials meet the requirements of the applicable sections listed in Section 40.2. Minimum number of tests is once each year per source unless otherwise ordered by the Engineer.

When the Contractor proposes to use a mix design not previously accepted by the City, the Contractor shall obtain independent, certified laboratory tests that verify that the mix design meets a minimum flexural strength of 650 psi at 28 days. Minimum number of tests is once each year unless otherwise ordered by the Engineer. Test results shall include three each of: 7, 14, & 28 day compressive strength; 7, 14, & 28 day flexural strength; water-cement ratios; slump (to be consistent with proposed placement method); and air content. These results shall be obtained from separate mix design batches.

These mix design results will be used to monitor and adjust, if necessary, the PCC Pavement placed on the project.

In case satisfactory plasticity, workability, or strength is not secured using the design mix designated, the Engineer may alter proportions as necessary. Adjustment will not be made in the compensation due the Contractor because of design mix alterations.

For the Stationary Side Form Method, the slump of the concrete at the time of placement shall be maintained between one (1) and three (3) inches.

For the Slip-Form Method, the concrete shall be held at a uniform consistency, having a slump of not more than two (2) inches.

The concrete shall contain six (6) plus or minus one and five-tenths (± 1.5) percent-entrained air. Air shall be entrained by an approved air-entraining admixture.

B. Equipment:

Equipment shall be at the jobsite sufficiently ahead of the start of construction operations and be examined thoroughly.

1. Batching Equipment:

Batching Equipment shall be automatic. Manual operation will be permitted when automatic controls fail, however, the Contractor shall restore automatic operation before work may commence the day following the failure.

The Engineer may permit the use of manually controlled batching equipment when relatively small quantities of concrete are required at one or more locations.

The Contractor shall provide safe and satisfactory means for obtaining necessary material samples from the batching plant.

Batching plant structures shall be maintained properly leveled within the accuracy required by the design of the weighing mechanism.

Hoppers shall be constructed to fully discharge without excessively jarring the scales.

Clearances between scale parts, hoppers and bin structure shall be such as to avoid displacement of, or friction between parts due to accumulations, vibration or other cause. Pivot mountings shall be designed so the parts will not jar loose and so constructed to assure unchanging spacing of knife-edges under all circumstances. Scales shall be so designed that exposed fulcrums, clevises and similar working parts may readily be kept clean.

Weighing hoppers and other parts upon which wind action may cause inaccuracy in weighing shall be protected by shelters or wind breaks.

The dials of scales shall be completely enclosed in weatherproof cases and provided with a glass opening to permit observation and reading.

Dial scales shall be provided with markers, which indicate the position of the dial indicator for predetermined loads.

Beam scales shall be equipped with an over and under indicator, which will show the beam setting. The indicator shall have an over and under travel equal to not more than five (5%) percent of the capacity of the beam.

The scales for weighing aggregates, cement, water, sand, and admixtures shall be of the beam or spring less dial type designed as an integral part of the batching equipment. The scales shall be accurate within one-half percent (1/2%) at any point throughout the range of use of the scale. Scale graduations shall be not greater than one-tenth percent (0.1%) of the capacity of the scale. The scales shall be sensitive to the weight indicated by one graduation. The Contractor shall provide the necessary equipment and assistance for checking the scales at least once for every (6) days' operation.

The following controls shall apply to the aggregate batching equipment where each aggregate is weighed separately:

The hopper inlet mechanism shall be interlocked against opening when the discharge gate is open.

The hopper discharge mechanism shall be interlocked against opening while the hopper is being filled.

The hopper discharge mechanism shall be interlocked against opening if the material in the hopper is either overweight or underweight by more than two percent (2%) of the specified weight of the material being weighed.

The following controls shall apply to the aggregate batching equipment where aggregates are weighed accumulatively into one hopper:

Hopper inlet mechanisms shall be interlocked against opening when the hopper discharge gate is open.

The hopper inlet mechanism for any ingredient shall be interlocked against opening if the previous ingredients already in the hopper are overweight or underweight by more than one-half of one percent (1/2 of 1%) of the net weight of the total aggregate batch.

The hopper discharge mechanism shall be interlocked against opening while the hopper is being filled or if the batch in the hopper is overweight or underweight by more than one-half of one percent (1/2 of 1%) of the net weight of the total aggregate batch.

The cement batching equipment shall operate within a delivery tolerance of one percent (1%) of the net weight of the cement per batch.

Water may be measured by volume or by weight. The measuring equipment shall operate within a delivery tolerance of one percent (1%) of the net weight or volume of water per batch.

When water is measured by volume, the measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to provide for checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

Air-entraining or other admixtures may be measured by volume or by weight. The measuring equipment shall operate within a delivery tolerance of three percent (3%) of the net weight or volume per batch.

2. Mixing and Hauling Equipment:

Mixers and agitators shall have attached in a prominent place, the manufacturer's plate showing the various uses for which the equipment is designed and the capacity of the drum in terms of volume of mixed concrete.

The pick-up and throw-over blades in the drum shall be restored or replaced when any part or section is worn three-fourths (3/4) inch or more below the original height of the manufacturer's design.

The Contractor shall have available a copy of the manufacturer's design, showing dimensions and arrangement of blades in reference to the original height and depth. Mixers that have an accumulation of hard concrete or mortar in them shall not be used.

Mixers, except truck mixers, shall be equipped with an approved timing device, which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The timing device shall be equipped with a bell or other suitable warning device adjusted to give a signal each time the lock is released.

Truck mixers shall be equipped with counters by which the number of revolutions of the drum or blades may readily be verified. The counters shall be automatically actuated at the time of starting mixing at mixing speed.

Mixers shall be capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and discharging the concrete with a satisfactory degree of uniformity.

The hauling bodies of non-agitating equipment shall be smooth, mortar-tight metal containers equipped with gates that will permit control of the discharge of the concrete.

3. Spreading and Finishing Equipment:

The equipment shall consist of a mechanized spreading device, a strike-off, an oscillating transverse screed and a final float. Slip-form paving equipment shall have the direction of forward motion controlled by an electronic sensing device following a taut string line. The equipment shall be designed to spread, consolidate, screed and float-finish the freshly placed concrete in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement.

4. Vibrators:

Vibrators, for full width vibration of concrete paving slabs, may be either the surface pan type or the internal type. They may be attached to the spreader, the finishing machine or mounted on a separate carriage. The frequency of the surface vibrators shall not be less than three thousand five hundred (3,500) impulses per minute. The frequency of the internal vibrators shall not be less than seven thousand (7,000) impulses per minute, unless modified by the Engineer. When spud type internal vibrators are used adjacent to forms, they shall have a frequency of not less than three thousand five hundred (3,500) impulses per minute. Vibrators shall be interlocked with the machine's travel mechanism so vibration is stopped when the forward motion stops.

5. Concrete Saw:

When sawing joints is elected or specified, the Contractor shall provide sawing equipment adequate in number of joints and power to complete the sawing to the required dimensions and at the required rate. The Contractor may be required to provide at least one (1) standby saw in good working order.

6. Forms:

Forms shall have a depth not less than the prescribed edge thickness of the pavement. Built up forms with horizontal joints shall not be used unless specifically approved by the Engineer. Forms shall have sufficient rigidity and shall be provided with adequate devices for secure setting so, when staked in place, they will withstand the pressure of the concrete and the impact and vibration of any equipment they are required to support, without significant springing, settlement or lateral displacement. Bent, twisted or broken forms and those with battered top surfaces shall be removed from the work. Repaired forms shall not be used until inspected and approved. The top face of any form shall not vary from a true plane by more than one-eighth (1/8) inch in ten (10) feet.

Straight forms shall be made of metal having a thickness of not less than seven-thirty seconds ($7/32$) of an inch and shall be furnished in sections not less than ten (10) feet in length, with each section having provisions for locking together the ends of abutting sections. Straight forms shall have a base width of at least eight (8) inches with flange braces extending outward on the base at least two-thirds ($2/3$) the height of the form.

Flexible or curved forms of proper radius shall be used for curves of one hundred (100) foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer.

C. Preparation:

1. Stationary Side Form Method:

Forms shall be set to line and grade. The surface to receive concrete shall be final graded and dowel assemblies if required, placed sufficiently in advance of concrete placement.

The foundation under the forms shall be compacted and true to grade so the form will be firmly in contact for its whole length. Forms shall be staked into place with not less than three (3) pins for each ten (10) foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked and free from play or movement. The forms shall not deviate from true line by more than one-fourth ($1/4$) inch at any point. Excessive settlement or springing of forms under the finishing machine will not be tolerated. Forms shall be cleaned and oiled prior to the placing of concrete.

Alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. When forms have been disturbed or the grade has become unstable, the forms shall be reset and rechecked.

After side forms have been set to line and grade and securely fastened, the surface on which the concrete paving is to be placed, excluding asphalt concrete and cement treated base, shall be brought to final grade by a sub grade machine or sub grade planner. High areas shall be trimmed to proper elevation. Low areas may be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete integral with the pavement.

In lieu of the above operation, an automatic sub grade trimmer operating from a preset grade line may be used prior to setting of the side forms. The machine shall cover in one (1) pass, a width at least equal to the out to out dimensions of the forms. After the grade has been made by the automatic sub grade trimmer, the forms shall be set, the surface checked, and high and low, areas corrected as specified above.

The finished sub grade surface shall be maintained in a smooth and compacted condition until the pavement is placed.

2. Slip Form Method:

The surface on which the concrete is to be placed, excluding asphalt concrete and cement treated base, shall be brought to final grade by an automatic sub grade trimmer operating from a preset grade line. The machine shall cover in one (1) pass, a width at least equal to the out to out dimensions of the slip form paver tracks. Grade control for the paving operation shall be off of the final trimmed surface or from a preset string line.

If the density of the surface is disturbed by the trimming operations, it shall be corrected by additional compaction before concrete is placed. If any traffic is allowed to use the prepared sub grade, the grade shall be checked and corrected immediately ahead of concrete placement.

D. Handling, Measuring, and Batching Materials:

The separate aggregate components shall not become intermixed prior to being weighted. The weigh hopper or hoppers shall be charged in such manner as to result in batched weights within the tolerances specified.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to secure a uniform grading of the material. The use of track-type dozing equipment will not be permitted in handling coarse aggregates from stockpiles. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. If the aggregates contain non-uniform moisture, storage or stockpile periods may be required by the Engineer to equalize the moisture content.

The separate aggregate components for each batch may be weighed cumulatively in a single hopper or weighed separately in individual hoppers. Separate scales and hoppers shall be used for weighing cement.

E. Mixing Concrete:

Concrete shall be mixed at a central stationary plant. Truck mixing will be permitted only when shown on the plans or authorized by the Engineer.

Mixing and agitating speeds shall be as designated by the manufacturer of the equipment.

Manual operation of the central plant will be permitted only in case of failure of the automatic control. Automatic operation must be restored before work may commence the day following the failure.

Batches for the central plant shall be charged into a drum so a portion of the mixing water enters in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period.

Concrete mixed less than the specified time shall be disposed of at the Contractor's expense.

Mixers may not be charged in excess of their rated capacity.

When a concrete batch is to be transported in a truck mixer or agitator and the batch is smaller than sixty percent (60%) of the rated capacity of the truck mixer or agitator, the following percentage of additional cement shall be added to the batch:

40% to 60% rated cap	5%
20% to 40% rated cap	10%
10% to 20% rated cap	15%
0% to 10% rated cap	20%

The above provisions regarding extra cement shall also apply to the mixing of small batches in central plants as well as to the transporting.

1. Central Plant Mixing:

Concrete shall be mixed for a period of not less than one (1) minute after all materials, excluding water, are in the mixer.

2. Truck Mixing:

Mixing time for truck mixed concrete shall be not less than seventy (70) nor more than one hundred (100) revolutions of the drum or blades at mixing speed, after all ingredients, including water, are in the drum. Additional mixing beyond one hundred (100) revolutions, if any, shall be done at agitating speed. Unless otherwise permitted by the Engineer, the mixing water shall be added at the time of batching. The Engineer may order additional water or cement added to the batch after completion of the original mixing, in which case the batch shall be mixed an additional thirty (30) revolutions at mixing speed. The Contractor shall provide means to accurately measure the amount of water added.

F. Limitations of Mixing:

Concrete shall be mixed in such quantities as required for immediate use and shall be finished before initial set has occurred. Concrete in which initial set has begun shall be wasted. Retempering of concrete will not be allowed. Concrete shall not be mixed, placed, or finished when the natural light is insufficient, unless otherwise shown on the plans.

Mixing water shall not be heated above one hundred sixty (160°) degrees F. Aggregates shall not be heated above one hundred (100°) degrees F. and shall be free of frozen lumps, ice, and snow.

G. Delivery requirements:

The rate of delivery of concrete shall be uniform.

When concrete is continuously agitated in the hauling unit, it shall be discharged within ninety (90) minutes after the cement has been placed in contact with the aggregates, except when the concrete temperature is eighty five (85°) degrees F. or above, the time limitation shall be forty-five (45) minutes.

When concrete is not continuously agitated in the hauling unit, it shall be discharged within forty-five (45) minutes after the cement has been placed in contact with the aggregates, except when the concrete temperature is eighty (80°) degrees F. or above, the time limitation shall be thirty (30) minutes.

The compartment in which concrete is transported to the worksite shall be thoroughly cleaned and flushed with water at such intervals as necessary to insure hardened concrete will not accumulate in the compartment.

H. Placing Concrete:

Placement of concrete on a frozen surface will not be permitted. The surface of forms and steel, which will come into contact with the concrete, shall be raised to a temperature above freezing prior to concrete placement.

The temperature of concrete at the time of placing shall not be less than fifty (50°) degrees F, or more than ninety (90°) degrees F.

The subgrade surface shall be uniformly moist when the concrete is placed. Sprinkling shall be such as to avoid forming pools of water.

The concrete shall be deposited on the grade so as to require as little rehandling as possible. Unless truck mixers, truck agitators or non-agitating hauling equipment are equipped to discharge concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade without segregation of the materials.

Necessary hand spreading shall be done with shovels, not rakes or vibrators. Workers shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Vehicles will not be allowed to drive through or back into fresh mixed concrete if they are tracking earth or foreign substances. Equipment that has earth or foreign substances dropping from the unit will not be allowed over the fresh mixed concrete.

Where concrete is to be placed adjoining a previously constructed lane of pavement, and heavy mechanical spreaders or finishers will be operated upon the existing lane of pavement, that lane shall have attained a compressive strength of at least three thousand five hundred (3500) psi. Spreaders and finishers or other vehicles or equipment having less than 2000 psi ground load will be permitted on the existing lane when it has attained a compressive strength of two thousand five hundred (2500) psi. Compressive strength will be determined in accordance with Test No. SD 409.

Concrete shall be thoroughly consolidated against and along the faces of all forms by vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade or a side form. The vibrator shall not be operated longer than ten(10) seconds in any one location.

Concrete shall be deposited as near as possible to expansion and contraction joints without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly, unless the hopper is well centered on the joint assembly.

Concrete material, which falls on or is worked into the surface of a completed slab, shall be removed immediately by approved methods without damage to the slab.

I. Protection of Concrete:

The Contractor shall protect the pavement with sufficient covering so the concrete surface temperature is maintained above thirty-two (32°) degrees F. until the concrete has attained a compressive strength of one thousand five hundred (1500) psi. Compressive strength will be determined in accordance with Test No. SD 409. This protection shall be in addition to one of the curing methods specified in this section.

Any concrete placed between November 1 and April 15, shall be covered by insulated blankets or equivalent heat retention methods unless, such requirements are waived by the Engineer.

The Contractor shall be responsible for the quality and strength of concrete subjected to cold weather. Any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

The Contractor shall have available at all times covering materials such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop, and the unhardened concrete shall be covered with the protective covering.

J. Test Specimens:

The Contractor shall furnish from the mixture in actual use sufficient concrete for the purpose of making test specimens as required in 40.3.V. herein.

K. Strike-Off of Concrete and Placement of Reinforcement:

Following placement, the concrete shall be struck-off to conform to the cross section shown on the plans, so when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the plans. Portland Cement Concrete shoulders shall not be constructed above nor more than one-fourth (1/4) inch lower than adjacent Portland Cement Concrete Pavement. In slabs reinforced with non-continuous steel fabric or bar mats, concrete may be placed in two (2) separate horizontal layers.

Each layer shall be spread and struck-off at the correct elevation to permit placement of the reinforcement in the specified position. The second layer shall be placed while the first layer of concrete is plastic and both layers shall be properly vibrated to ensure adequate consolidation and a monolithic pavement structure. In lieu of placement in two (2) layers, the full depth of concrete may be placed in one (1) layer and the steel inserted by a mesh depressor. In continuously reinforced concrete slabs, the reinforcement shall be supported on chairs and the entire slab poured in one operation. The chairs used for support shall rigidly hold the reinforcement in position during concreting operations, without displacement.

Reinforcement shall be free from dryer concrete, dirt, oil, paint, grease, mill scale, and loose or thick rust, which could impair bond with the concrete.

L. Joints:

Joints shall be constructed of the type and dimensions and at the locations required by the plans or specifications. Immediately after sawing the joints to their final configuration, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water and other tools as necessary.

1. Longitudinal Sawed Joints:

1. Deformed #4 epoxy coated steel tie bars of specified length, spacing, and material shall be placed perpendicular to the longitudinal joints by approved mechanical equipment or rigidly secured by chairs or other approved supports, to prevent displacement. Tie bars shall not be painted or coated with asphalt or other such material, other than the epoxy coating or enclosed in tubes or sleeves. Longitudinal sawed joints shall be, cut by approved concrete saws to the depth, width and line shown on the Standard Details. Suitable guidelines or devices shall be used to assure cutting the longitudinal joint on the true line as shown on the plans. The longitudinal joint shall be sawed shortly after the end of the curing period and before any equipment or vehicles are allowed on the pavement. The joint shall be sealed as required in Section 40.3Q.

2. Longitudinal Construction Joints:

When adjacent lanes of pavement are constructed separately, a keyway shall be formed along the construction joint. When deformed #4 epoxy coated steel tie bars are required, they may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed. In lieu of bent tie bars, approved two-piece connectors may be used. Deformed #4 epoxy coated steel tie bars shall conform to the requirements specified in Section 40.3L.1, except that rail steel shall not be used for tie bars that are to be bent and restraightened. The longitudinal construction joint shall be sawed shortly after the end of the curing period and shall be sealed as required in Section 40.3Q.

When new PCC pavement is to be constructed adjacent to existing pavement and where a keyway is not present, deformed #10 epoxy coated bars shall be drilled and epoxied into the existing pavement. The bars shall be installed to a depth of nine (9) inches and placed eighteen (18) inches on centers.

3. Transverse Contraction Joints:

Transverse contraction joints shall consist of planes of weakness one-third (1/3) the depth of the pavement. They may be created by sawing, forming with approved inserts, or by a combination of forming and sawing.

Sawed transverse contraction joints shall be created by sawing grooves in the surface of the pavement to the dimensions and at the spacing and lines shown on the plans with an approved concrete saw. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling. Joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both during the day and night, regardless of weather conditions. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw.

Any procedure, which results in premature and uncontrolled cracking, shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or removal of curing media and the cutting of joints. Repair or correction of uncontrolled cracks shall be as directed by the Engineer and at the expense of the Contractor unless a determination is made that cracking is the result of improper design.

Formed transverse contraction joints shall be created by installing an insert, which will be removed after the concrete has hardened. The insert shall be installed immediately behind the last finishing machine and shall be placed as close to the pavement surface as finishing will permit. The insert shall be placed

by a device or by an installing machine to the depth shown on the plans. Inserts shall not be removed sooner than seventy-two (72) hours after the pavement is poured, unless the joint opening is properly cured as set forth in Section 40.30.

4. Transverse Construction Joints:

Transverse construction joints, unless other joints shown on the plans occur at the same points, shall be made at the end of each day's run. Transverse construction joints shall also be placed when the paving operation is interrupted and the in-place concrete is no longer plastic enough so a monolithic slab can be obtained.

The transverse construction joint shall be located at the middle of the paving panel. Supplemental hand vibrators shall be immediately available in the event normal equipment does not provide satisfactory consolidation at joints.

Transverse construction joints shall be made using a satisfactory header and reinforcing bars of the size, length, and spacing shown on the plans. Reinforcing bars shall be held in position parallel to the surface and centerline of the slab. Transverse construction joints shall be sawed one-fourth (1/4) inch wide by three-fourths (3/4) inch deep and sealed with joint sealer.

Paving in the area of a transverse construction joint will not be permitted for twelve (12) hours after installation.

5. Transverse Expansion Joints:

Transverse expansion joints shall consist of placement of preformed expansion joint filler at the intervals and in the manner specified.

Preformed joint filler shall be formed to the required size and location for the load transfer units as shown on the plans. The preformed joint filler shall be furnished in lengths equal to the pavement width. In cases where pavement is being placed two (2) or more traffic lanes wide, the preformed filler may be furnished in sections equal to the width of one lane. Where more than one section of joint filler is used in a joint, the sections shall be securely laced or clipped together. The bottom edge of the filler shall project to or slightly below the bottom of the slab. Unless otherwise prescribed, the top edge shall be about three-fourths (3/4) inch below the proposed surface of the pavement to facilitate the finishing operations. While the concrete is being placed, the top edge of the filler shall be protected by a metal channel cap having flanges not less than one and one-half (1 ½) inches in depth.

6. Concrete Headers:

Concrete headers, when designated on the plans, shall be placed full pavement width at the starting point, and at the end of the finished pavement. Headers

shall also be constructed at such other points as may be ordered by the Engineer. Concrete headers shall be of the design shown on the plans.

M. Final Strike-Off, Consolidation and Finishing:

1. Sequence:

The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging, and final surface finish.

The addition of water to the surface of the concrete to assist in finishing operations will not be permitted, except under extreme conditions. In isolated areas where the Engineer determines the addition of water would be beneficial, water may be applied with an approved fog sprayer.

2. Finishing at Joints:

The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Section 40.3H.

3. Machine Finishing:

Vibrators meeting the requirements of Section 40.3B.4 shall be used for full width vibration of concrete paving slabs.

Immediately after placement, the concrete shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary for proper consolidation and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine. The travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish.

During the first pass of the finishing machine, a ridge of concrete shall be maintained ahead of the front screed for its entire length.

The finishing machine shall be operated with as nearly a continuous forward movement as possible, and all operations of mixing, delivering, spreading, and vibrating concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. Except in an emergency, no tractive force shall be applied to the machine, except that which is controlled from the machine.

The Contractor shall furnish equipment and methods, which will produce uniform and satisfactory consolidation of the concrete.

4. Hand Finishing:

Hand finishing methods will not be permitted except when areas of narrow width or irregular dimensions are encountered that cannot be finished with mechanical equipment.

In the event of mechanical equipment breakdown, the concrete already deposited on the grade shall be hand finished, and additional concrete placement shall be terminated.

Hand finishing shall be done in a manner acceptable to the Engineer.

5. Floating:

After the concrete has been struck off and consolidated, the surface shall be further smoothed, trued, and consolidated by means of an approved mechanical longitudinal float, consisting of a cutting and smoothing float or floats included as part of the finish machine or suspended from a separate rigid frame.

If necessary, long-handled floats having blades not less than five (5) feet in length and six (6) inches in width may be used to smooth and fill open-textured areas in the pavement.

Long-handled floats shall not be used to float the entire surface of the pavement. Care shall be taken not to work the crown out of the pavement during the operation.

After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge ten (10) feet or more in length. Successive drags shall be lapped one-half (1/2) the length of the blade.

6. Final Finish:

Before the concrete has attained its initial set, it shall be given a final finish by means of a carpet drag drawn over the surface in a longitudinal direction. The drag shall be mounted on a bridge and the dimensions of the drag shall be such that a strip of the carpet at least two (2) feet wide is in contact with the pavement surface while the drag is operated, unless otherwise allowed by the Engineer.

The condition of the drag shall be maintained so the resultant surface is of uniform appearance with corrugations approximately one-sixteenth (1/16) inch in depth. Drags shall be maintained clean and free of encrusted mortar. Drags that cannot be cleaned shall be discarded and replaced

The carpet shall meet the following requirements:

- Facing Material - Molded polyethylene pile face
- Blade Length - 7/8 inch, plus or minus 1/8 inch
- Total Fabric Weight - 70 oz. per square yard minimum

The backing shall be of a strong, durable material, not subject to rot, and adequately bonded to the facing, to withstand construction requirements.

If approved by the Engineer, brooming may be used on irregular areas in lieu of the carpet drag. The broom shall be drawn transversely across the pavement with adjacent strokes slightly overlapping. The brooming operation shall be so executed that the grooves produced in the surface shall be uniform in appearance and approximately one-sixteenth (1/16) inch in depth. Texturing shall be completed while the concrete surface can be broomed without being torn or unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas and irregularities and depressions resulting from improper handling of the broom. Brooms shall be of the quality, size, and construction and so operated as to produce a surface finish meeting the approval of the Engineer.

7. Edging at Forms and Joints:

After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of transverse expansion joints and transverse construction joints shall be worked with an approved tool and rounded to the radius required by the plans. Edging will be permitted along longitudinal construction joints provided the radius does not exceed one-fourth (1/4) inch. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not, be unduly disturbed by tilting of the tool during use. On formed contraction joints, the bond between concrete and insert shall be broken by insertion of an approved tool between the plastic concrete and the insert.

Any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming, belting, or burlap dragging the surface without disturbing the rounding of the corner of the slab. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straightedge before the concrete has set and correction made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

N. Surface Test

The pavement surface shall be tested with a ten (10) foot straightedge or other specified device. The permissible longitudinal and transverse surface deviation shall be one-fourth (1/4) inch in ten (10) feet. The permissible transverse surface

deviation on the outer six (6) inches of the edge of pavement may be one-fourth (1/4) inch under a ten (10) foot straightedge, except where the edge will become a longitudinal joint.

Areas where the maximum deviation exceeds the permissible deviation by not more than three-eighths (3/8) inch will be subject to the following at the discretion of the Engineer:

Grind down to an elevation where the area or spot will be within the permissible deviation.

Accept affected area without corrective action with price reduction at a rate noted below.

Areas where the maximum deviation exceeds the permissible by more than three-eighths (3/8) inch will be subject to the following at the discretion of the Engineer:

Grind down to an elevation where the area or spot will be within the permissible deviation.

Accept affected area without corrective action with price reduction at a rate noted below.

Remove and replace deficient area to the satisfaction of the Engineer.

Grinding shall be accomplished with specially prepared circular diamond blades mounted on a horizontal shaft. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground concrete.

If the Engineer accepts the deficient area without correction, a price reduction at the following rates will be deducted from the contract.

Ten dollars (\$10.00) per square yard for those areas where the maximum deviation exceeds the permissible deviation by not more than one-eighth (1/8) inch.

Twenty dollars (\$20.00) per square yard for those areas where the maximum deviation exceeds the permissible deviation by more than one-eighth (1/8) inch but not more than three-eighths (3/8) inch.

Thirty dollars (\$30.00) per square yard for those areas where the maximum deviation exceeds the permissible deviation by more than three-eighths (3/8) inch.

Measurements for determining the limits of deficient areas accepted by the Engineer with applicable price reduction will be made in the following manner:

The longitudinal pavement surface test shall be completed on each wheel pass on driving lanes and on at least one pass on shoulder, etc. The length of the

deviation will be that length out of specification tolerance at the location of the surface test as checked with a ten (10) foot straightedge and a one-fourth (1/4) inch shim surface tolerance is specified. Where two (2) surface tests vary within a particular site within a driving lane or shoulder, the length used for computation of the area will be the average of the two (2) tests. The width will be the total width of the particular driving lane or shoulder. The depth of the deviation will be the maximum depth of the test(s) at a particular site, as checked with one-eighth (1/8) inch, one-fourth (1/4) inch, and three-eighths (3/8) inch shims.

Where the transverse surface test is out of specification, the maximum length and maximum width at a particular site shall be used in computation of the area.

O. Curing:

Immediately after the finishing operations have been completed, and marring of the concrete will not occur, the entire surface and the edges of the slip-form pavement shall be covered and cured in accordance with one of the following methods. The concrete shall not be left exposed for more than one-half (1/2) hour between stages of curing or during the curing period. Curing shall be maintained for at least seventy-two (72) hours after concrete has been placed.

1. Cotton or Burlap Mats and White Polyethylene Sheeting:

The surface of the concrete pavement and both pavement edges shall be covered with cotton or burlap mats. Prior to placement, the mats shall be thoroughly saturated with water and placed with the wettest side down.

Immediately after placement, the mats shall be covered with white polyethylene sheeting placed in accordance with paragraph 3 below. The mats shall be kept moist by periodic applications of water.

2. Impervious Membrane Method:

The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mats. The curing compound shall not be applied during or immediately after rainfall. Curing compound shall be, applied under pressure by approved self-propelled mechanical sprayers. The curing compound may be applied in either one (1) or two (2) applications in accordance with the directions of the manufacturer. If applied in two (2) coatings, the second shall be applied not later than thirty (30) minutes after the first. The rate of application shall be one (1) gallon to not more than one hundred fifty (150) square feet for carpet drag or broom finished surfaces and one (1) gallon to not more than one hundred twenty-five (125) square feet for metal tine-finished surfaces. The spraying equipment shall be equipped with a tank agitator and be fully atomizing. The spray fog shall be protected from the wind by an adequate shield. At the time of use, the

compound shall be in a thoroughly mixed condition. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd width or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed, unless such compound will be completely removed by subsequent sawing operations. Ropes of moistened paper, fiber, or other suitable material shall be used to seal the top of the joint opening.

Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the slab exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

3. White Opaque Polyethylene Sheeting:

The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least eighteen (18) inches. The sheeting shall be placed and weighted down to maintain intimate contact with the surface covered. The sheeting, as prepared for use, shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. In cold weather, the Engineer may permit the substitution of dark sheeting for white sheeting.

P. Removing Forms:

Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least twelve (12) hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed without damaging the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above.

Q. Sealing Joints:

Joints shall be sealed with hot-poured elastic joint sealer or low modulus silicone sealant as specified on the plans. Joints shall be sealed before the pavement is opened to traffic and as soon after completion of the curing period as is feasible.

Joint grooves shall be inspected for spalling. Spalls greater than one-half (1/2) inch in depth, which impair the performance of the seal shall be repaired by patching with an epoxy mortar approved by the Engineer. Loose concrete shall be removed from the spalled area, and the spalled concrete surface shall be thoroughly cleaned. Construction shall be such that a vertical face is provided and the joint width is maintained. After cleaning, the spalled surface shall be primed, and an epoxy mortar of troweling consistency shall be placed in the spalled area and finished as the original pavement surface. After the epoxy mortar has cured, the forming material shall be carefully removed.

The epoxy binder components shall be mixed in the proportions and by methods recommended by the manufacturer. After the epoxy binder is, thoroughly mixed, dry silica sand shall be blended into the mixture to give an epoxy mortar of trowelable consistency.

Patching of spalls shall be done only when the temperature of the air and pavement are above forty (40°) degrees F.

Joints shall not be sealed unless they are thoroughly clean and dry. All materials such as old sealant, oil, asphalt, curing compound, paint, rust, and other foreign materials shall be completely removed. Cleaning shall be accomplished by sand blasting and other tools as necessary.

Just prior to sealing, each joint shall be blown out using a jet of compressed air at a working pressure of not less than ninety (90) psi to remove all trace of dust. Air compressors used for cleaning joints shall be equipped with traps capable of removing all free water and oil from the compressed air.

Joint sealer application will not be permitted when the air temperature near the joint is less than forty (40°) degrees F. or is forty (40°) degrees F. and falling.

The sealant shall be applied so the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned.

Failure of the joint material in either adhesion or cohesion will be cause for rejection, and repair shall be made at the Contractor's expense.

1. Hot-Poured Elastic Joint Sealer:

Hot-poured elastic joint sealer shall be stirred during heating so localized overheating does not occur. All joints shall be sealed with an approved pressure sealing device equipped with a nozzle inserted into the joint so sealing material will be forced from the bottom of the joint to the top.

2. Silicone Sealant:

Silicone sealant shall be applied with an approved mechanical device suitable for the intended use and shall be equipped with a nozzle or spout shaped to fit into the joint. The sealant to fill the joint shall be applied under pressure from the inside of the joint to remove entrapped air and ensure good joint contact.

Backer rod of the required size shall be installed to the proper depth to produce the width and depth of sealant shown on the plans. Stretching the backer rod during installation will not be permitted.

The sealant surface shall be tooled to produce a slightly concaved surface approximately one-fourth (1/4) inch below the pavement surface. Tooling shall be accomplished before a skin forms on the surface. The use of soap or oil as a tooling aid will not be permitted.

R. Protection of Pavement:

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include guards to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, etc. Crossovers will not be permitted until the concrete is at least twenty-four (24) hours old.

Any damaged or defective pavement shall be repaired as directed by the Engineer. When a pavement is to be removed and replaced, the Engineer will specify the dimensions of the pavement to be removed.

Uncontrolled cracking shall be repaired at the Contractor's expense. Transverse cracks shall be repaired by pressure injection with an approved epoxy material or by an alternate method approved by the Engineer. Longitudinal cracks shall be repaired by routing and sealing with an approved white or gray joint sealing material.

S. Opening to Traffic:

The pavement shall not be opened to traffic until the concrete has attained a compressive strength of four thousand (4000) pounds per square inch. The compressive strength may be checked by means of cylinders or by using a Swiss Impact Hammer in accordance with Test No. SD 409. Prior to opening to traffic, the pavement shall be cleaned.

T. Concrete Patching:

Concrete replacement for utilities, storm sewer, or similar work shall comply with the requirements herein and as follows:

1. Joints formed by new concrete and existing concrete shall be tied by drilling and epoxy grouting #10 deformed, epoxy coated rebar eighteen (18) inches long into existing concrete at mid-depth. Rebar shall extend eighteen (18) inches into new concrete. Tie bars are to be located on eighteen (18) inch centers, but no closer than six (6) inches from corners of existing concrete. This shall include existing curb and gutter.
2. Joint sawing and sealing shall be as shown for tie-bar joint or transverse contraction joint as applicable.
3. Existing joints shall be utilized as much as possible. New joints formed by this work shall be kept to a minimum.

4. Concrete streets with asphalt overlays shall be repaired as described above, except that joints may be tooled, and sealing will be waived. Asphalt overlay shall extend (6) inches beyond new pavement edges.
5. Sound, vertically straight, fully supported, unbroken edges of existing concrete will be required prior to placing new concrete.
6. Measurement and payment for this work to be in accordance with Sections 40.4 and 40.5

U. Tolerance in Pavement Thickness:

The thickness of the pavement will be determined by average caliper measurement of cores tested in accordance with AASHTO T 148 and thickness will be reported to accuracy specified herein.

Cores may be taken in areas the Engineer has reason to believe are deficient in thickness. These core measurements will not be used to determine pavement thickness as set forth in the following:

For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as those lengths of pavement, as specified below, starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be the appropriate length in feet for the width involved plus the fractional part of that length in feet remaining. Width of pavement represented by cores shall be the pavement surface between adjacent longitudinal construction joints, between a longitudinal construction joint and the pavement edge, or between two (2) pavement edges where the entire width of pavement is poured in one (1) operation.

Each ramp will be considered as a unit, and small irregular areas such as intersections, entrances, crossovers, etc., may be included as part of an adjacent unit.

<u>Width of Pavement to be Represented by Cores</u>	<u>Length of Unit</u>	<u>Intervals for Additional Cores</u>
up to and including 15 ft.	1,500 ft.	400 ft.
over 15 ft. thru 30 ft.	1,000 ft.	300 ft.
over 30 ft. thru 42 ft.	750 ft.	225 ft.
over 42 ft.	500 ft.	150 ft.

One (1) core may be taken at random by the Engineer in each unit. When the measurement of the core from a unit is not deficient more than two-tenths (0.2) inch from the plan thickness, full payment will be made. When such measurement is deficient more than two-tenths (0.2) inch and not more than one (1.0) inch from the plan thickness, two (2) additional cores at intervals not less than those specified above for the width of pavement represented will be taken and used in the average

thickness for that unit. An adjusted unit price as hereinafter specified will be paid for the unit represented by the cores, if the average thickness is determined to be deficient by more than two-tenths (0.2) inch. If the average thickness is not deficient by more than two-tenths (0.2) inch, full payment will be made. The average thickness will be determined by numerically averaging measurements. Location of cores will not be a factor in determining average thickness for a unit. The average thickness will be reported to the nearest one-tenth (0.1) inch.

In calculating the average thickness of the pavement measurements which are in excess of the specified thickness by more than two-tenths (0.2) inch will be considered as the specified thickness plus two-tenths (0.2) inch, and measurements which are less than the specified thickness by more than one (1.0) inch will not be included in the average. When any core is found to be deficient by more than one (1.0) inch, the length of such deficient pavement shall be determined by the procedure hereinafter described and another core shall be taken to replace the one, which was found to be deficient by more than one (1.0) inch.

When the measurement of any core is less than the specified thickness by more than one (1.0) inch, the actual thickness of the pavement in this area will be determined by taking additional cores at not less than twenty-five (25) foot intervals parallel to the centerline in each direction from the affected location, until in each direction a core is found which is not deficient by more than one (1.0) inch. The point at which the pavement is deficient by exactly one (1.0) inch will be found by assuming a straight line relationship between the core which is deficient by more than one (1.0) inch and the core which is deficient by less than one (1.0) inch. Areas found deficient in thickness by more than one (1.0) inch will not be used in averages for adjusted unit price.

**PORTLAND CEMENT CONCRETE PAVEMENT
8 INCHES AND UNDER**

Deficiency in Thickness Determined by Cores (Inches)		Proportional Part of Contract Price Allowed
From	Through	
0.00	0.20	100 per cent
0.21	0.30	80 per cent
0.31	0.40	72 per cent
0.41	0.50	68 per cent
0.51	0.70	57 per cent
0.71	1.00	50 per cent

**PORTLAND CEMENT CONCRETE PAVEMENT
OVER 8 INCHES**

Deficiency in Thickness Determined by Cores (Inches)		Proportional Part Of Contract Price Allowed
From	Through	
0.00	0.20	100 per cent
0.21	0.30	85 per cent
0.31	0.40	77 per cent
0.41	0.50	73 per cent
0.51	0.70	62 per cent
0.71	1.00	55 per cent

The foregoing provisions for tolerance in pavement thickness will apply to Portland cement concrete shoulders with the following modifications: Each shoulder will be cored separately. Unit lengths are defined as two thousand (2000) lineal feet. Full payment will be made when core deficiency is not more than three-tenths (0.3) inch from plan thickness. Additional cores in a unit will be taken at intervals of not less than six hundred (600) feet.

PORTLAND CEMENT CONCRETE SHOULDERS

Deficiency in Thickness Determined by Cores (Inches)		Proportional Part of Contract Price Allowed
From	Through	
0.00	0.30	100 per cent
0.31	0.40	80 per cent
0.41	0.50	72 per cent
0.51	0.60	68 per cent
0.61	0.80	57 per cent
0.81	1.00	50 per cent

V. Strength and Thickness Tests:

The Contractor shall submit the following test data. All sampling and testing shall be done by certified testing laboratory personnel.

Slump, air content, seven (7) and twenty-eight (28) day compressive and flexural strength.

One test per 250 lineal feet of main line paving.

One test per 250 square yards of patching.

Thickness cores per Section 40.3U.

All test results shall be submitted to the Engineer.

Failing strength tests shall be pro-rated as follows:

$$D = [(A - B) / A] * C$$

A = Specified strength

B = Average of all tests below specified strength

C = Number of failing tests divided by total number of tests times one hundred (100)

D = Percent reduction in unit price bid

If C is twenty percent (20%) or greater, the Contractor shall extend the pavement warranty period an additional two years. The City reserves the right to order additional tests. The Contractor shall pay for those additional tests that fail to meet specified strength and the City will pay for those additional tests that do meet the specified strength.

The Engineer or his representative shall be present for all field sampling and lab testing performed by/for the Contractor. Failure to notify the City of pending sampling or testing could result in rejection of submitted data and re-testing by in-place methods.

All required data shall be received by the Engineer before payment for pavement exceeds seventy-five percent (75%) of the total quantity.

40.4 METHOD OF MEASUREMENT

- A. Portland Cement Concrete Pavement, Portland Cement Concrete Shoulders, and Portland Cement Concrete Pavement - Miscellaneous:

These items will be measured by the square yard for pavement accepted, complete, in place. Pavement which is removed or for which no payment will be made, as set forth under Section 40.3U, will not be measured for payment. When an item for Portland Cement Concrete Pavement - Miscellaneous is provided in the contract, the areas of concrete pavement to be measured under this item will be described on the plans.

- B. Concrete Headers:

This item will be measured in square yards. Quantities measured under this item will not be included under the items of Concrete Pavement.

C. Admixtures:

When admixtures other than air-entraining admixtures are required by the Engineer, they will be measured in pounds, with computations based on the theoretical factor specified in the job-mix, the plan shown thickness of the concrete pavement, and the number of square yards of concrete pavement accepted for payment.

40.5 BASIS OF PAYMENT

A. Portland Cement Concrete Pavement, Portland Cement Concrete Shoulders, and Portland Cement Concrete Pavement - Miscellaneous:

These items will be paid for at the contract unit price per square yard to the nearest tenth (0.1) square yard, or the adjusted unit price as set forth in Section 40.3V.

Payment for these items will be full compensation for furnishing all materials, except admixtures specified by the Engineer, and for labor, equipment, sampling and testing and incidentals necessary to satisfactorily construct the concrete pavement. These items will also be full compensation for water used to moisten the sub grade ahead of the paver and that used for curing the concrete.

The amount bid on these items will be based on the plan shown quantity of cement per cubic yard or five hundred sixty-four (564) pounds per cubic yard for pavement and pavement - miscellaneous and five hundred twenty (520) pounds per cubic yard for shoulders, in the event no cement factor is shown on the plans.

B. Concrete Headers:

This item will be paid for at one and one-half (1 1/2) times the contract unit price per square yard of Portland Cement Concrete Pavement, which price will be full compensation for materials, labor, equipment, and incidentals necessary to satisfactorily construct the concrete headers.

C. Admixtures:

Payment for admixtures (other than air-entraining admixtures) will be made at the Contractor's cost f.o.b. jobsite material yard to the nearest whole pound, when such admixtures are specified by the Engineer. Separate payment will not be made for admixtures used at the option of the Contractor.

Compensation provided under this item will be full payment for furnishing the admixtures at the batching site.

END OF SECTION

SECTION 41

UTILITY TRENCH RESURFACING

41.1 DESCRIPTION

A. General:

This work consists of furnishing and installing surface patching of utility trenches. This includes all equipment, tools, materials, labor, and other incidentals to provide utility trench patching, complete and ready for continuous use.

Patching of trenches will be matching the in-place surface material with asphalt, concrete, gravel, grass, etc. or as specified by the Engineer.

B. Related Work:

Section 20	Granular Materials
Section 31	Asphalt Concrete - General
Section 33	Asphalt Concrete - Class G
Section 39	Cold Mix Asphalt Concrete
Section 40	Portland Cement Concrete Pavement
Section 70	Seeding
Section 73	Sodding
Section 90	Traffic Control
Section 117	Aggregates for Granular Bases and Surfacing
Section 202	Engineering Fabric

C. Submittals:

Submittals shall be required unless otherwise specified in the Detailed Specifications.

The term "Submittals" includes manufacturer's product data sheets of pipe and fittings and supplier certification for asphalt mix, concrete mix, gravel base, granular backfill to be used on the project.

At least five (5) working days before his need for approval, the Contractor shall forward to the Engineer three (3) copies of submittals for all products. Submittals will be accepted only from the Contractor.

The Engineer will indicate his approval or disapproval of each submittal and, if he does not approve the submittal as submitted, will indicate his reasons therefore. Any work done prior to approval shall be at the Contractor's own risk. Approvals shall not relieve the Contractor from responsibility for complying with the requirements of the contract documents.

Re-submittals shall be made the same as for original submittals, with changes from the previous submittal clearly shown.

41.2 MATERIALS (Not specified)

41.3 CONSTRUCTION REQUIREMENTS

A. Sub grade Preparation:

Contractor shall not resurface the trench until all density tests have been met and the Engineer gives approval.

The sub grade shall be brought to proper grade elevation, for the specified depth of surfacing to be placed. The sub grade surface shall be smooth and level, with no loose material.

B. Resurfacing:

1. Saw cut of pavement edges:

Initial saw cuts shall be placed a minimum of one foot outside the proposed trench wall width on both sides. The width between initial pavement saw cuts should not be less than six feet. The second, or final, saw cuts shall be a minimum of one foot outside of any pavement damage beyond the initial saw cuts..

2. Asphalt street:

The asphalt patch shall be placed to a minimum depth of five (5) inches. If the existing pavement is greater than five (5) inches thick, the patch shall be placed to a depth matching the existing pavement. The asphalt base shall be Class G, Type 1, and/or class G type II, as approved by the Engineer. The asphalt patching shall be in accordance with Sections 33 and 39.

3. Cold Mix Asphalt:

A temporary asphalt patch shall be placed when hot asphalt is not available and/or the Engineer gives approval. The Contractor shall be responsible for maintenance of the temporary patch at no extra cost to the City. The depth of the temporary patch shall be a minimum of five (5) inches. The cold mix shall be in accordance with Section 39.

4. Concrete street with asphalt overlay:

After saw cutting per specifications, the concrete base patch shall be poured to the depth of the existing concrete. The concrete shall be allowed to attain a

compressive strength of 4000 psi, or the Engineer has given approval, before the asphalt overlay can be accomplished. The asphalt overlay shall be Class G, Type I and/or Class G, type II as approved by the Engineer. The concrete and asphalt patch shall be in accordance with Sections 31, 33, and 40.

5. Concrete street:

After saw cutting as per specifications, the concrete pavement patch shall be installed in accordance with Section 40.3T. The pavement patch shall not be opened to traffic until the concrete has attained a compressive strength of 4000 psi. The concrete patch shall be in accordance with Section 40.

6. Asphalt blotter street:

The specifications for asphalt street shall apply, except the depth of the asphalt patch shall be the depth of the existing blotter, or three inches whichever is greater, or as approved by the Engineer.

7. Gravel resurfacing:

The gravel shall be placed to a thickness equal to the in-place gravel thickness or five inches, whichever is greater, or as approved by the Engineer. The gravel surface material and placement shall be in accordance with Section 20 and Section 117.

8. Seeding:

The area to be seeded shall be as specified on the plans and specifications and/or by the Engineer. The seeding shall be in accordance with Section 70.

9. Sodding:

The area to be sodded shall be as specified on the plans and specifications and/or by the Engineer. The sodding shall be in accordance with Section 73.

10. Engineering Geogrid/Fabric:

If Engineering fabric is encountered during excavation, the Contractor shall immediately notify the Engineer. Damaged fabric shall be repaired as shown on the appropriate standard detail or as directed by the Engineer. Final saw cuts shall be as specified above in 41.2.,B.1. Also see Section 202 Engineering Fabric.

11. Under-drains:

If subsurface or edge drains are encountered during excavation, the Contractor shall immediately notify the Engineer. Subsurface or edge drains shall be repaired as shown on the appropriate standard detail or as directed by the

Engineer. Final saw cuts shall be as specified above in 41.2.B.1. Also see section 64 Under-drains.

41.4 METHOD OF MEASUREMENT

A. Asphalt patch:

All asphalt patching shall be measured to the nearest tenth (0.1) ton of material placed.

B. Concrete patch:

All concrete patching shall be measured to the nearest whole square yard of patch surface.

C. Gravel surface:

All gravel replacement shall be in accordance with Section 20.

D. Seeding:

All seeding shall be measured to the nearest whole square yard of area seeded.

E. Sodding:

All sodding shall be measured to the nearest whole square yard of area sodded.

F. Engineering Fabric:

All engineering fabric shall be measured to the nearest whole square yard of surface covered, exclusive of overlap.

41.5 BASIS OF PAYMENT

All resurfacing shall be paid for in accordance with the respective section as indicated in the "Basis of Payment" in that section.

END OF SECTION

SECTION 51

STRUCTURE EXCAVATION FOR BOX CULVERTS

51.1 DESCRIPTION

A. General

This work consists of the necessary foundation excavation for box culverts.

B. Related Work

Section 11 Utility Excavation and Backfill
Section 12 Roadway and Drainage Excavation
Section 14 Embankment
Section 15 Disposal of Surplus Excavation and Waste
Section 52 Box, Pipe, and Plate Culvert Undercutting

51.2 MATERIALS (Not Specified)

51.3 CONSTRUCTION REQUIREMENTS

A. Depth of Excavation

The elevation of the bottoms of footings shown on the plans, are approximate and the Engineer may order in writing such changes in elevations of footings as necessary.

B. Treatment of Foundation

Rock or other hard foundation material shall be free of loose material, cleaned and cut to a firm surface, and either level, stepped, or serrated.

Where concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Concrete shall not be placed until the depth of excavation has been checked and the suitability of the foundation material approved by the Engineer.

Foundation excavation may be trimmed to the exact size of the footing and the footing forms omitted, if soil conditions permit and when approved by the Engineer.

Removal of unstable material below the bedding grade of box culverts shall be performed as set forth in Section 52.

Where foundation piles are used, the excavation of each foundation bed shall be completed before the piles are driven. After the pile, driving is completed; loose and displaced material shall be removed or compacted to a smooth solid bed at or below plan elevation.

C. Disposal of Excavation Material

The excavated material shall be used for backfill and embankment, disposed of as indicated on the plans, or directed by the Engineer. Excavated material shall not be placed and left in streambeds, except for the filling of holes and construction of stream control features.

D. Preservation of Channels

Unless otherwise specified, excavation shall not be made outside of caissons, cribs, cofferdams, steel piling or sheeting, and the natural streambed adjacent to the structure shall not be disturbed. If any excavation or dredging is done at the site of the structure before caissons, cribs, or cofferdams are in place, the Contractor shall backfill all excavations to the original ground surface or streambed with satisfactory material after the foundation is in place.

E. Cofferdams and Cribs

Cofferdams and cribs for foundation construction shall be carried to adequate depths and heights, be safely designed and constructed, and be made as water-tight as necessary for the proper performance of the work which must be done inside them. The interior dimensions of cofferdams and cribs shall give sufficient clearance for the construction of forms and the inspection of their interiors and permit pumping outside of the forms.

Cofferdams or cribs, which are tilted or moved laterally during the process of sinking shall be righted, reset, or enlarged to provide the necessary clearance at the expense of the Contractor.

Cofferdams or cribs shall be constructed to protect fresh concrete against damage from sudden rising of the stream and to prevent damage to the foundation by erosion. Timber or bracing shall not be left in cofferdams or cribs in such a way as to extend into the substructure concrete without written permission from the Engineer.

Cofferdams or cribs, inclusive of all sheeting and bracing, shall be removed after the completion of the substructure without disturbing or otherwise damaging the finished masonry.

F. Inspection

The Contractor shall notify the Engineer as soon as each excavation is completed. Concrete or piling shall not be placed until the Engineer has approved the depth and size of the excavation and the foundation material.

G. Backfill Above Bedding Grade

Backfill shall be compacted in accordance with the provisions of Section 14 and herein.

Spaces not occupied by abutments, piers or other permanent work shall be backfilled up to the surface of the surrounding ground, with a sufficient allowance for settlement.

Material used for backfill shall be of an acceptable quality and shall be free from large or frozen lumps, wood or other extraneous material. Backfill shall be satisfactorily compacted in horizontal layers not to exceed six (6) inches loose depth.

The slope bounding the excavation for abutments and wing walls shall be stepped or roughened to prevent wedge action of the backfill against the concrete.

Backfill placed around box culverts, walls and piers shall be deposited on both sides to approximately the same elevation at the same time.

51.4 METHOD OF MEASUREMENT

A. Excavation

Excavation for wood structures and drilled-in foundations will be measured as set forth on the plans.

The removal of water will not be considered a measurable item nor will allowance be made for duplication, sloughed material, or material removed due to mudflows.

Structure excavation will be measured by the cubic yard. The plan shown quantity will be the quantity accepted for payment. Field measurements for Structure Excavation quantities will not be made, unless the City determines that conditions warrant such measurement.

B. Structure Excavation, Box Culvert

When a box culvert is constructed at or above the flow line shown on the plans, the plan shown quantity of structure excavation will be the pay quantity. This quantity of excavation will be equal to the volume of concrete below the flow line.

When the Engineer orders the flow line lowered on construction, the material excavated between the plan shown flow line and the as-constructed flow line will be measured for payment as Unclassified Excavation, unless it is unstable material and must be removed by a dragline, backhoe, or similar equipment, and will be measured as "Structure Excavation, Box Culvert" and added to the plan shown quantity.

51.5 BASIS OF PAYMENT

When there is an item for "Structure Excavation, Box Culvert", payment will be at the contract unit price per cubic yard for "Structure Excavation, Box Culvert". When no item is provided for "Structure Excavation, Box Culvert", payment for work under this item will be made at the contract unit price per cubic yard for the various excavation items in accordance with Section 11, UTILITY EXCAVATION AND BACKFILL.

Payment will be considered full compensation for furnishing materials, labor, equipment, tools, and incidental necessary to complete the work.

END OF SECTION

SECTION 52

BOX, PIPE, AND PLATE CULVERT UNDERCUTTING

52.1 DESCRIPTION

A. General

This work consists of the removal of unstable material or rock, either in ledge or boulder formation, below the bedding grade of box, pipe, and plate pipe culverts and the backfilling of undercut areas.

B. Related Work Items

Section 11	Utility Excavation and Backfill
Section 12	Roadway and Drainage Excavation
Section 14	Embankment
Section 15	Disposal of Surplus Excavation and Waste
Section 20	Granular Materials
Section 51	Structure Excavation for Box Culverts
Section 112	Select Granular Backfill

52.2 MATERIALS

A. Box Culverts

Material for backfilling undercut areas of box culverts shall consist of gravel or other material suitable to the Engineer.

B. Pipe and Plate Pipe Culverts

Material for backfilling undercut areas of pipe and plate pipe culverts shall consist of soil or gravel selected material.

52.3 CONSTRUCTION REQUIREMENTS

A. Undercutting excavation

Undercutting shall be performed to the lines and grades set forth on the plans or as otherwise ordered by the Engineer. The width of undercutting for pipe culverts will be the diameter of the pipe plus four (4) feet or the span or arch pipe plus four (4) feet unless otherwise ordered by the Engineer. Undercut material shall be disposed of as directed by the Engineer.

B. Backfill

Backfill shall be satisfactorily compacted in horizontal layers of not to exceed six (6) inches loose depth.

52.4 METHOD OF MEASUREMENT

Authorized undercutting of box, pipe, and plate pipe culverts will be measured to the nearest whole cubic yard. The width, length, and lower limits will be as shown on the plans or as otherwise directed by the Engineer. The upper limit will be the bedding grade for box culverts and the lower face of the pipe for pipe and plate pipe culverts, except the upper limit for pipe culverts to be installed on a Class B bedding will be one (1) foot below the lower face of the pipe.

52.5 BASIS OF PAYMENT

When an item is provided in the contract, this work will be paid for at the contract price per cubic yard to the nearest whole cubic yard for "Undercutting Culverts." When an item for "Undercutting Culverts" is provided in the contract, and undercutting of culverts is required at locations other than those specified on the plans, such undercutting will also be paid for at the contract price for "Undercutting Culverts."

When an item for "Undercutting Culverts" is not provided in the contract, payment for undercutting will be made as follows:

Undercutting for box culverts will be paid for at two and one-half (2 1/2) times the contract unit price for "Structure Excavation, Box Culvert".

Undercutting for pipe and plate pipe culverts will be paid for at six dollars (\$6.00) per cubic yard or twenty (20) times the contract unit price for Unclassified Excavation, whichever is least.

The above payment will be full compensation for equipment, labor and for furnishing, placing and compacting backfill material, including water, in place of the excavated material.

END OF SECTION

SECTION 53

DRAINAGE FABRIC PROTECTION FOR REINFORCED CONCRETE BOX CULVERT

53.1 DESCRIPTION

A. General

This work consists of placement of drainage fabric protection around the outside of reinforced concrete box culvert joints.

B. Related Work Items

Section 108 - Concrete-Curing Materials
Section 202 - Engineering Fabric

53.2 MATERIALS

A. Drainage Fabric shall conform to the requirements of Section 202.

B. Polyethylene Sheeting shall conform to the requirements of Section 108.

53.3 CONSTRUCTION REQUIREMENTS

Drainage fabric shall be placed entirely around each joint in the box culvert barrel. The fabric shall be placed to provide a minimum of two and one-half (2 1/2) feet of fabric centered on the joint. Where required, transverse joints in the fabric shall be accomplished by overlapping the fabric a minimum of two (2) feet. Polyethylene sheeting shall be placed between the fabric and the concrete box culvert. During bottom slab construction, the fabric and polyethylene sheeting shall be placed prior to concrete placement. Sufficient adhesive will be permitted along the edge of the fabric and polyethylene sheeting to hold it in place during backfilling.

53.4 METHOD OF MEASUREMENT

Separate measurement will not be made.

53.5 BASIS OF PAYMENT

Separate payment will not be made. The cost of furnishing and installing drainage fabric will be absorbed in the contract items.

END OF SECTION

SECTION 54

PIPE CULVERTS

54.1 DESCRIPTION

A. General

This work consists of furnishing and installing concrete and metal culverts and storm drains (storm sewers), excluding structural metal plate culverts. Pipe culverts shall be in accordance with Section 11 – Utility Excavation and Backfill except as modified by the provisions contained here within.

B. Related Work Items

Section 11	Utility Excavation and Backfill
Section 12	Roadway and Drainage Excavation
Section 15	Disposal of Surplus Excavation and Waste
Section 52	Box, Pipe, and Plate Culvert Undercutting
Section 62	Drop Inlets
Section 63	Storm Sewer Manholes
Section 65	Riprap
Section 66	Slope Protection
Section 68	Bank and Channel Protection Rock Filled Wire Baskets
Section 109	Riprap and Slope Materials
Section 112	Select Granular Backfill
Section 120	Reinforced Concrete Pipe
Section 121	Corrugated Metal Pipe
Section 125	Gabions

54.2 MATERIALS

- A. Reinforced concrete pipe shall conform to the requirements of Section 120, REINFORCED CONCRETE PIPE.
- B. Corrugated metal pipe shall conform to the requirements of Section 121, CORRUGATED METAL PIPE.

54.3 CONSTRUCTION REQUIREMENTS

A. Concrete Pipe

Concrete pipe culverts shall be laid with the groove or bell end of the pipe upstream and the tongue end shall be inserted into the groove. Except where watertight

rubber gaskets are used, each joint shall be covered over the top three-fourths (3/4) of the outside circumference of the pipe, with at least a six (6) inch wide strip of composition roofing paper or drainage fabric. This strip shall be centered over the joint and cemented with a plastic asphalt cement to hold it in place during embankment construction.

Lift holes shall be covered or plugged to prevent backfill from entering the pipe.

When the plans require the use of rubber gaskets at joints, they shall be installed according to the manufacturer's instructions.

B. Corrugated Metal Culverts

Corrugated metal culverts are approved for use as driveway cross pipe only. Corrugated metal pipe shall not be used within the public right of way or under the street paving section with the exception of corrugated metal pipe used in strip drain applications and only with the written approval of the Engineer. Such strip drains shall be bedded and backfilled with concrete or flowable fill only. Corrugated metal culverts shall be laid with outside laps of circumferential joints pointing upstream and with the longitudinal laps on the sides. The ends of the pipe sections shall be approximately one (1) inch apart to enable corrugations of the bands to mesh with the corrugations of the pipe.

Multiple lines of pipe culverts shall be laid in truly parallel lines in all planes.

The amount of camber shall be varied to suit the height of fill and nature of supporting soil.

Proper equipment shall be provided by the Contractor, for lowering the sections of pipe into place. Dropping the pipe into place will not be permitted.

C. Excavation

Trenches shall be excavated to a width sufficient to allow for proper jointing of the pipe and thorough compaction of the bedding and backfill material under and around the pipe. Where soil type allows, trench walls shall be vertical to an elevation atop the pipe.

The completed trench bottom shall be firm for its full length and width.

The foundation for each type of bedding shall be adequate to furnish a uniform stable support. Removal of unstable material or rock below bedding grade shall be performed as set forth in Section 12.

D. Bedding

The pipe bedding shall conform to one of the classes described below as specified. When no bedding class is specified, the requirement for Class C bedding shall apply.

1. Class A Bedding

This bedding shall consist of a continuous concrete cradle conforming to the plan details.

2. Class B Bedding (Ring Compression Design)

Material shall be excavated from below the bottom of the pipe grade for a depth of twelve (12) inches and for a width equal to the external diameter of the pipe plus one (1) foot. The excavated area shall be backfilled with select fill material to at least fifteen percent (15%) of the pipe's overall height above the lower face of the pipe. The material shall be thoroughly compacted to provide a firm uniform foundation. The foundation shall then be shaped to fit the lower part of the pipe, and the pipe shall be bedded on a three (3) inch layer of suitable granular material. Select fill material shall then be placed in six (6) inch layers and compacted with mechanical tampers, to at least thirty percent (30%) of the overall pipe height.

When the pipe foundation is entirely in new embankment, the twelve (12) inch undercut will be waived, provided select fill material was used for the embankment.

3. Class C Bedding

This bedding shall consist of an earth or gravel cradle of uniform density shaped to fit the lower part of the pipe with reasonable closeness for at least ten percent (10%) of the pipe's overall height.

- E. Backfill Above Bedding Grade

Pipe shall be backfilled to the elevation shown on the plans or as directed by the Engineer. Backfilling shall conform to the requirements for Normal Type Backfill or Imperfect Trench Backfill as specified. When backfilling requirements are not specified, the requirements for Normal Type Backfill will apply. Moisture and density requirements for backfill shall be as specified for project embankment or as directed by the Engineer. Backfill material shall be pre-moistened if necessary to obtain uniform moisture.

1. Normal Type Backfill

Selected embankment material shall be placed along the pipe in layers not exceeding six (6) inches loose depth and thoroughly compacted by mechanical compactors to the required density before successive layers are placed.

The width of the berms on each side of the pipe shall be twice as wide as the external diameter of the pipe, or twelve (12) feet, whichever is least. This

method of backfilling shall be continued until the embankment is at least two (2) feet over the top of the pipe.

In trench installations, backfill width shall be equal to trench width. The backfill shall be brought up evenly on both sides of the pipe for its full length. This method of backfilling shall be continued until the embankment is at least two (2) feet over the top of the pipe.

2. Imperfect Trench Backfill (Concrete Pipe Only)

Imperfect Trench Backfill shall be designed and specified as required for aspecific project.

F. Replacing Disturbed Surfacing Material

In the event that pipe culvert installation requires the removal or disturbing of surfacing material, and no items or quantities of replacement surfacing are provided in the contract, the Contractor shall replace the disturbed surfacing to the satisfaction of the Engineer.

G. Pipe Culvert and Storm Drain (Storm Sewer) Tests:

1. General: A visual inspection and a TV inspection test shall be performed as specified herein for all pipe culverts and storm drains (storm sewers) as a condition of acceptance by the City. All tests shall be performed after backfill is complete but prior to any surface restoration. In addition the designer or Engineer may supplement this specification by also specifying a leakage test.
2. Pre-Cleaning: Prior to testing newly installed pipe culverts and storm drains (storm sewers), the Contractor shall remove all accumulated construction debris, rock, gravel, sand, silt, and other foreign matter from the pipe.

The Contractor shall be responsible for all work necessary to make the pipe culverts and storm drains (storm sewers) acceptable for usage including removal of all mud, silt, rocks, or blockages that make said pipes unacceptable for final acceptance and usage. Also included is all work necessary in the Drop inlets, Storm Sewer Manholes and all cleanup work required prior to final acceptance.

The City will not be responsible for cleaning lines prior to televising the pipe culverts and storm drains (storm sewers). In the event that the line is not acceptable for televising, due to the Contractor's operations, the Contractor will be notified. It will be the Contractor's responsibility to arrange to clean the pipe culverts and storm drains (storm sewers) and make them acceptable for the television work. If not cleaned in a timely manner, the City may cause to take any actions necessary and charge the Contractor one and a half (1½) times the cost incurred.

3. Visual Tests: All newly installed pipe culverts and storm drains (storm sewers) pipe shall pass a visual, or "lamping", inspection by the Engineer, and a television inspection by the City Utility Maintenance Division. Straight alignment shall be checked either with lamping or with the laser beam. Lamping shall be conducted by viewing the pipe from inside a drop inlet or storm sewer manhole to determine proper alignment. The television inspection shall consist of viewing the inside of all pipe culverts and storm drains (storm sewers) installed to determine proper alignment, grade, joining, etc. The Contractor shall correct, at his own expense, any defects discovered because of lamping and/or televising the pipe.

Both a visual and television inspection shall be completed unless specified otherwise in the Detailed Specifications or on the Drawings. Waiving the visual or television inspections shall only be done in writing by the Engineer and will only be considered if requested by the design engineer.

The expense of the initial television inspection and one additional reinspection will be borne entirely by the City. If defective workmanship of material or construction is noted, the Contractor at no expense to the City, shall correct the deficiency. The City will perform additional television inspections to review if the repairs were made properly and in accordance with the specifications. The expense of any additional television inspections beyond the initial inspection and one additional reinspection will be borne entirely by the Contractor. The Contractor shall be responsible for all related costs, including concrete or asphalt resurfacing if the street has been surfaced. The Contractor shall be required to repair all deficiencies. The City may cause to take any actions necessary for any items not completed or repaired in a timely manner and may charge the contractor one and a half (1½) times the costs incurred.

It is the Contractors responsibilities to notify both the Engineer/City Inspector and Utility Maintenance that the pipe culverts and storm drains (storm sewers) are ready for inspection. From the time initial notification that the pipe culverts and storm drains (storm sewers) are ready to be inspected the Contractor shall allow the City at least four (4) weeks to perform the television inspection. Any surfacing started prior to televising the pipe culverts and storm drains (storm sewers) and said pipe culverts and storm drains (storm sewers) being accepted is at the Contractors own risk.

4. Leakage Tests: If required by detailed specifications or by notes on the drawings, the Contractor shall conduct leakage testing of all newly constructed or reconstructed pipe culverts and storm drains (storm sewers). The Contractor shall furnish all necessary equipment and be responsible for conducting the leakage test in the presence of the Engineer and/or project Inspector.

Refer to the detailed specifications or notes on the drawings for specific testing methods and requirements. Pipeline segments between drop inlets or storm sewer manholes shall be tested separately. Mechanical or pneumatic plugs shall

be placed in the line at opposing drop inlets or storm sewer manholes and each plug braced as a safety precaution.

54.4 METHOD OF MEASUREMENT

A. Furnishing and Installing Pipe Culverts

Furnishing and installing pipe culverts will be measured by the linear foot of the respective type, classes, and sizes of acceptable pipe culverts furnished, installed, and accepted. The footage will be obtained by multiplying the nominal length of the sections by the number of sections installed.

When an installation requires that a section of pipe be cut, such as storm sewer installations, the footage will be the actual length required, rounded up to the nearest even two (2) feet.

B. Furnishing and Installing Flared End Sections

Furnishing and installing flared end sections for the respective type and sizes of pipe culverts will be measured by the number of complete flared end sections installed and accepted, including tie bolts or bands.

C. Replacing Disturbed Surfacing Material

Measurement will not be made for this item unless otherwise specified.

54.5 BASIS OF PAYMENT

A. Furnishing and Installing Pipe Culverts

Furnishing and installing pipe culverts will be paid for at the contract unit price per linear foot for the respective designated types, classes, and sizes installed.

Payment for this item will be full compensation for furnishing and installing the pipe culverts, special sections, gaskets, connecting devices, and coupling bands. It will also be full compensation for necessary bedding operations, cost of selecting and placing backfill, furnishing and installing required granular or other bedding materials, testing, and necessary excavation required, with the exception of authorized excavation of material below pipe foundation.

B. Furnishing and Installing Flared End Sections

Furnishing and installing flared end sections will be paid for at the contract unit price per each for the respective type and size installed, including tie bolts or bands.

C. C. Replacing Disturbed Surfacing Material

Unless otherwise specified, separate payment will not be made. The cost of replacement shall be absorbed in the bid item for pipe culverts.

END OF SECTION

SECTION 55

CONCRETE MASONRY

55.1 DESCRIPTION

A. General

This work consists of false work and form construction and the furnishing, handling, placing, curing, and finishing of concrete for structures.

B. Related Work

Section 57	Reinforcement for Concrete Masonry
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 108	Concrete Curing Materials
Section 113	Preformed Expansion Joint Filler for Concrete
Section 114	Concrete Joint Sealer
Section 123	Reinforcement

55.2 MATERIALS

- A. Cement shall conform to the requirements of Section 100. Type II cement shall be used for all concrete.
- B. Fine Aggregate shall conform to the requirements of Section 105.
- C. Coarse Aggregate shall conform to the requirements of Section 107.
- D. Water shall conform to the requirements of Section 104.
- E. Admixtures shall conform to the requirements of Section 101 and 102.
- F. Reinforcing Steel shall conform to the requirements of Sections 57 and 123.
- G. Curing Materials shall conform to the requirements of Section 108.
- H. Joint Filler shall conform to the requirements of Section 113.

- I. Joint Sealer shall conform to the requirements of Section 114.

55.3 CONSTRUCTION REQUIREMENTS

A. Quality of Concrete, Proportioning, and Mix Design

When the Contractor proposes to use materials for Portland Cement Concrete pavement from sources not previously accepted by the City, the Contractor shall obtain independent, certified laboratory tests that verify that the materials meet the requirements of the applicable sections listed in Section 55.2. Minimum number of tests is once each year per source unless otherwise ordered by the Engineer.

When the Contractor proposes to use a mix design not previously accepted by the Owner, the Contractor shall obtain independent, certified laboratory tests that verify that the mix design meets a minimum strength of 4000 psi at 28 days. Minimum number of tests is one test per mix design once each year, unless otherwise ordered by the Engineer. Test results shall include three each of 7-, 14-, and 28-day compressive strength; water-cement ratios; slump (to be consistent with proposed placement method), and air content. These results shall be obtained from separate mix design batches.

These mix design results will be used to monitor and adjust, if necessary, the PCC Pavement placed on the project.

The Contractor shall proportion the materials as set forth in the laboratory design mix. In case satisfactory plasticity, workability, or strength is not secured using the design mix designated, the Engineer may alter proportions as necessary. Adjustment will not be made in the compensation due the Contractor because of design mix alterations.

The slump of the concrete at the time of placement shall be maintained between two and five inches. The slump of the concrete used in bridge decks shall be maintained between one inch and three and one-half inches at the time of placement.

Concrete, except that used in bridge decks, shall contain six percent, plus or minus one and five-tenths percent entrained air. Concrete used in bridge decks shall contain six percent plus or minus one percent entrained air. Air shall be entrained by means of an approved air-entraining admixture.

B. Equipment

Equipment shall be at the jobsite sufficiently ahead of the start of construction operations to be examined thoroughly.

1. Batching Equipment

Batching plant structures shall be maintained and properly leveled within the accuracy required by the design of the weighing mechanism.

Hoppers shall fully discharge without jarring the scales.

Clearances between scale parts, hoppers, and bin structure shall be such as to avoid displacement of, or friction between, parts due to accumulations, vibration, or other cause. Pivot mountings shall be designed so the parts will not jar loose and so constructed as to assure unchanging spacing of knife edges under all circumstances. Scales shall be so designed that exposed fulcrums, clevises, and similar working parts may readily be kept clean.

Weighing hoppers and other parts upon which wind action may cause inaccuracy in weighing shall be protected by means of shelters or wind breaks.

The dials of scales shall be completely enclosed in weatherproof cases and provided with a glass opening to permit observation and reading.

Dial scales shall be provided with markers to indicate the position of the dial indicator for predetermined loads.

Beam scales shall be equipped with an over and under indicator, which will show the beam in balance at zero load and at any beam setting. The indicator shall have an over and under travel equal to not more than five percent (5%) of the capacity of the beam.

The scales for weighing aggregates, cement, water, and admixtures shall be of the beam or spring less dial type designed as an integral part of the batch equipment. The scales shall be accurate within one-half percent (1/2%) at any point throughout the range of use of the scale. Scale graduations shall be no greater than one-tenth percent (0.1%) of the capacity of the scale. The scales shall not be sensitive to the weight indicated by one graduation.

When water is measured by volume, the measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve for checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

2. Mixing and Hauling Equipment

Mixers having a rated capacity of less than a one (1) bag batch shall not be used.

Mixers and agitators shall have attached, in a prominent place, the manufacturer's plate or plates showing the various uses for which the equipment

is designed and the capacity of the drum or container in terms of volume of mixed concrete.

The pickup and throw-over blades in the drum shall be restored or replaced when any part or section is worn down three-fourths (3/4) inches or more below the original height of the manufacturer's design. The Contractor shall have available a copy of the manufacturer's design showing dimensions and arrangement of blades in reference to original height and depth. Mixers that have an accumulation of hard concrete or mortar in them shall not be used.

Mixers, except truck mixers, shall be equipped with an approved timing device, which will automatically lock the discharge lever, when the drum has been charged, and release it at the end of the mixing period. The timing device shall be equipped with a bell or other suitable warning device adjusted to give a signal each time the lock is released.

Truck mixers shall be equipped with counters by which the number of revolutions of the drum or blades may readily be verified. The counters shall be automatically actuated at the time of starting mixing at mixing speed.

Mixers shall be capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and discharging the concrete with a satisfactory degree of uniformity.

The hauling bodies of non-agitating equipment shall be smooth, mortar-tight metal containers equipped with gates that permit control of the discharge of the concrete.

3. Wood Forms

Forms shall be designed, built, and maintained to sustain the pressure and weight of the green concrete and construction loads, which will come upon them. The design of the forms shall take into account the effect of vibration of the concrete as it is placed.

Forms or form lumber, which is to be reused, shall be clean and in good condition. Lumber that is split, warped, bulged, or marred, or that has other defects which may produce inferior work shall not be used.

The forms for concrete surfaces shall be constructed to produce mortar-tight joints and smooth, even, concrete surfaces. Forms shall be filleted at all sharp corners and shall be given a bevel or draft in all projections, such as girders and copings, to insure easy removal.

The required strength and smoothness may be obtained by lined forms or metal forms.

Metal ties or anchorages within the forms shall be constructed to permit their placement without injury to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least one-quarter inch from the face of the concrete. Fittings for metal ties shall be of such design that, upon removal, the cavities that are left, will be of the smallest practical size.

Forms shall be set and maintained true to the line designated until removal is permitted. When forms appear to be unsatisfactory, either before or during the placing of concrete, the Engineer shall order the work stopped until the defects have been corrected.

Forms shall be surface treated with oil or saturated with water immediately before placing the concrete. For members with exposed faces, the forms shall be surface treated with an approved oil to prevent the adherence of concrete. Material, which will adhere to or discolor the concrete, shall not be used.

4. Metal Forms

The requirements for wood forms, in regards to design, mortar tightness, filleted corners, beveled projections, bracing, alignment, reuse, and oiling shall also apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. Bolt and rivet heads shall be countersunk. Clamps, pins, or other connecting devices shall hold the forms rigidly together and allow removal without injury to the concrete. Metal forms, which do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep metal forms free from rust, grease, and other foreign matter, which will discolor the concrete.

C. False work

The Contractor shall submit four sets of detailed false work and centering plans for all bridges for review. The plans shall be submitted to provide the Engineer ample time for review prior to placing concrete. The Contractor shall also state on the plans the approximate date that he intends to place the concrete. Concrete placement will not be permitted unless false work plans have been reviewed and comments conveyed to the Contractor.

False work and centering shall be designed and constructed to provide the necessary rigidity and to support the dead and live loads to which it may be subjected during construction, without appreciable settlement or deformation.

The Contractor shall be responsible for the use of these plans and the strength of false work and centering.

On continuous concrete bridges, transverse construction joints may be used at the one quarter (1/4) points of any span adjacent to interior bents, provided the following requirements are adhered to:

1. A false work bent must be located at each transverse construction joint.
2. A placing sequence indicating the location of all joints and the sequence and direction of placements must be submitted to the Engineer for approval.
3. Concrete shall attain a minimum strength of three thousand (3000) psi between successive pours.
4. False work plans shall be submitted with the placement sequence if not previously submitted.

D. Handling, Measuring, and Batching Materials

The separate aggregate components shall not become intermixed prior to being weighed, and the weigh hopper or hoppers shall be charged to result in batched weights within the following tolerances:

When fine and coarse aggregates are weighed cumulatively, the aggregate batching equipment shall be operated within a delivery tolerance of one-half of one percent of the net weight of the total aggregate batch.

When fine and coarse aggregates are weighed separately, the aggregate batching equipment shall be operated within a delivery tolerance of two percent of the weight of the material being weighed.

Cement shall be measured by the sack or by weight. When cement is weighed, separate scales and hoppers shall be used with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. The cement batching equipment shall be operated within a delivery tolerance of one percent of the net weight of the cement per batch.

Water may be measured by volume or by weight. The measuring equipment shall be operated within a delivery tolerance of one percent of the net weight or volume of water per batch.

Air-entraining or other admixtures may be measured by volume or by weight. The measuring equipment shall be operated within a delivery tolerance of three percent of the net weight or volume of admixture per batch.

E. Mixing Concrete

Except as otherwise restricted by delivery or placement time, concrete may be mixed at a central stationary plant site or in truck mixers.

Mixers shall not be charged in excess of the rated capacity.

When a concrete batch is transported in a truck mixer or agitator and the batch is smaller than 60 percent of the rated capacity of the truck mixer or agitator, the following percentage of additional cement shall be added to the batch:

40% to 60% rated cap	5%
20% to 40% rated cap	10%
10% to 20% rated cap	15%
0% to 10% rated cap	20%

The above provisions regarding extra cement shall also apply to the mixing of small batches in central plants as well as to the transporting.

Mixing and agitating speeds shall be designated by the manufacturer of the equipment.

1. Central Plant Mixing

Manual operation of mixers may be permitted only in the case of failure of the automatic timing device. Automatic operation must be restored before work may commence the day following the failure.

The batch shall be so charged into the drum that a portion of the mixing water enters in advance of the cement and aggregates. The flow of water shall be uniform, and all water shall be in the drum by the end of the first 15 seconds of the mixing period.

Concrete shall be mixed for a period of not less than one minute after all materials, excluding water, are in the mixer.

Concrete mixed less than the specified mixing time shall be discarded and disposed of by the Contractor.

2. Truck Mixing

Mixing time for truck mixed concrete shall be not less than 70, or more than 100 revolutions of the drum or blades at mixing speed after all ingredients, including water, are in the drum. Additional mixing beyond 100 revolutions, if any, shall be done at agitating speed.

Unless otherwise permitted by the Engineer, the mixing water required by the design mix, or as ordered, shall be added at the time of batching. The Engineer may order additional water and/or cement added to the batch after completion of the original mixing, in which case the batch shall be mixed an additional 30 revolutions at mixing speed. The Contractor shall provide means to accurately measure the amount of water added.

3. The water to cement ratio of concrete used for bridge decks shall not exceed 0.45 by weight.

F. Volumetric Batching and Continuous Mixing

Volumetric batching and continuous mixing of concrete will be permitted contingent on the equipment, calibration, and production meeting the following.

1. Equipment

The proportioning and mixing equipment shall be a self-contained, mobile, continuous mixer meeting the following requirements:

- a. The mixer shall be capable of carrying sufficient unmixed dry bulk cement, fine aggregate, coarse aggregate, admixtures, and water in separate compartments to produce not less than six cubic yards of concrete.

For full-depth bridge deck placements, the production capacity shall be a minimum of 60 cubic yards per hour. The Contractor shall satisfy the Engineer that production capabilities of the mixer are sufficient for the type and magnitude of the placement intended. More than one mixer may be required to provide a satisfactory placement rate.

- b. The mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter, visible at all times and equipped with a ticket printout, shall indicate this quantity.
- c. The mixer shall provide control of the flow of water introduced into the mixer. Water flow shall be coordinated with the cement and aggregate feeding mechanisms, and shall be readily adjustable to provide for minor variations in aggregate moisture. Water flow shall be indicated by a calibrated flow meter.

In addition to the flow meter, mixers used for bridge deck concrete, low slump concrete, and latex modified concrete shall be equipped with recording water meters capable of recording, to the nearest one-tenth (0.1) gallon, the number of gallons introduced into the mixer.

- d. The mixer shall be capable of being calibrated to automatically proportion and blend all components on a continuous or intermittent basis.
- e. The mixer shall provide positive control of admixtures introduced into the mix. Admixture flow shall be coordinated with the feeding mechanisms of the other ingredients and shall be readily adjustable. The admixture injection system shall meet the manufacturer's recommendations regarding type and design.
- f. When mixing latex modified concrete, the mixer shall be equipped with recording meters capable of recording, to the nearest one-tenth (0.1) gallon, the number of gallons of latex emulsion introduced into the mix.

2. Equipment Calibration

- a. An annual calibration and inspection certificate will be required for each mixer before the start of the first project for which the mixer will be used each year. This certificate can be from a State Department of Transportation review. The calibration will establish the meter count, i.e., the number of revolutions and discharge time in seconds required to dispense ninety-four (94) pounds of cement. Gate openings and pointer adjustments for aggregates and general operating condition of the equipment will also be inspected, as per the manufacturer's recommendations.

The Contractor shall have available at the calibration and inspection a representative to witness the calibration and a qualified mixer operator. The Contractor shall furnish all necessary scales, containers, stop watches, mixer operating manuals, and other materials and equipment necessary for the calibration and inspection.

- b. A materials discharge verification check may be ordered whenever, in the opinion of the Engineer, conditions warrant. Individual components may be ordered verified. On latex modified mixtures, cement and latex emulsion discharge shall be verified prior to the first placement on each project.
- c. Proportioning of individual components shall be within the following tolerances:

- Cement (weight percent) 0% to + 4%
- Fine Aggregate (weight percent) ± 2%
- Coarse Aggregate (weight percent)..... ± 2%
- Water (weight or volume percent)..... ± 1%
- Latex Emulsion (weight percent) ± 1%
- Yield (volume percent)..... ± 2%

The discharge time interval for components other than aggregates shall be the time established for the discharge of 94 pounds of cement. A lesser discharge time, approved by the Engineer, may be used for aggregates. Individual components used during discharge checks shall be from the same sources as those to be used on the project. When performing materials discharge checks, relative to minimum quantities of materials in the bins shall be adhered to.

If the cement discharge is not within the tolerance provided above, a new meter count and discharge time shall be established using calibration form DOT-293.

3. Proportioning and Mixing

The operations of proportioning and mixing concrete shall comply with the following requirements:

- a. The proportioning and mixing equipment operator shall be thoroughly familiar with the equipment and its operation.
- b. Mixers shall be clean and ingredients accurately proportioned.
- c. Concrete shall be mixed at the site in accordance with the specific requirements for the equipment used.
- d. Concrete as discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that finishing operations can proceed at a steady pace and the final finishing is completed before the formation of a plastic surface film.

4. Termination of Use

Permission for continued use of a mixer may be rescinded upon failure to maintain acceptable production or inability to meet the specifications for the type of concrete being produced.

G. Limitations of Mixing

Mixed concrete quantities shall be such quantities as required for immediate use and shall be placed before initial set has occurred. Concrete in which initial set has begun prior to beginning placement shall be wasted. Re-tempering of concrete will not be allowed.

Concrete shall not be mixed, placed, or finished when the natural light is insufficient to provide an acceptable product, unless an adequate and approved artificial lighting system is provided. Mixing water shall not be heated above 160°F. Aggregates shall not be heated above 100°F and shall be free of all frozen lumps, ice and snow.

H. Delivery Requirements

When concrete is continuously agitated in the hauling unit, it shall be discharged within 90 minutes after the cement has been placed in contact with the aggregates.

When the concrete temperature is 80°F or above, the time limitation shall be 45 minutes.

When concrete is not continuously agitated in the hauling unit, it shall be discharged within a period of 45 minutes after the cement has been placed in contact with the

aggregates, except the time limitation shall be 30 minutes when the concrete temperature is 80°F or above.

The rate of delivery of concrete to the job site shall be uniform. The interval between batches shall not exceed 30 minutes unless otherwise permitted by the Engineer.

I. Placing Concrete

The Contractor shall give the Engineer sufficient advance notice before starting to place concrete to permit inspection of forms, reinforcing steel and preparation for placing. Concrete shall not be placed without approval of the Engineer.

Placement of concrete on a frozen surface or frost of any depth will not be permitted. The surface of forms, steel, and adjacent concrete, which will encounter the concrete being placed, shall be raised to a temperature above freezing prior to placement.

The temperature of concrete immediately after placing shall be not less than 50°F or more than 90°F. The top limit for bridge deck concrete shall be 80°F.

Placement of concrete for bridge decks will not be permitted during the period from November 1 to April 1 without written authorization from the Engineer.

Before placing concrete, all sawdust, chips, other debris, and extraneous matter shall be removed from the interior of forms. Struts, stays, and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete, shall be removed when the fresh concrete has reached an elevation rendering their service unnecessary. These temporary members shall be removed from the forms and not buried in the concrete.

When concrete is deposited through a chute, the slope of the chute shall allow the concrete to flow slowly without segregation. The delivery point of the chute shall be as close as possible to the point of deposit. Chutes and spouts shall be kept clean and shall be thoroughly flushed with water before and after each run. The water used for flushing shall be discharged outside the forms.

Free fall of concrete shall not exceed five feet except where it is impractical to restrict the fall by drop chutes such as in thin walls or columns where the reinforcement is such as to prohibit the use of chutes. In such cases, methods of placement shall be such as to prevent objectionable separation of coarse aggregate.

The sequence of placing concrete, including the installation of construction joints, shall be as specified on the plans. Concrete shall be placed in continuous horizontal layers. Each layer shall be placed before the preceding layer has attained its initial set.

The concrete shall be consolidated by vibrating internally or externally, or both, as directed by the Engineer. The vibrating shall be done with care to avoid displacement of reinforcing or forms. The vibration shall be of sufficient duration and

intensity to thoroughly consolidate the concrete but shall not be continued to cause segregation, localized areas of grout, or damage to concrete, forms, and reinforcement.

Vibration shall not be applied directly to reinforcement, which extends into sections or layers of concrete, which have hardened to the degree that the concrete ceases to be plastic under vibration. Vibrators shall not be used to make concrete flow over distances and shall not be used to transport concrete in the forms.

Accumulations of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed to the satisfaction of the Engineer. Care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcing steel. Dried mortar chips and dust shall not be puddled into the unset concrete.

J. Depositing Concrete in Water

Concrete shall not be deposited into or under flowing water. Concrete may be placed in or under still water only under the following conditions and under the immediate supervision of the Engineer. Concrete placed in or under still water shall be of the class required with an additional ten percent cement.

1. If water courses and sumps are provided outside of the area over which concrete is to be placed, and it is demonstrated that the water elevation can be controlled at or near the bottom with no appreciable flow across the area, the Contractor will be permitted to place the concrete. The placement of concrete shall start at a point most remote from the sumps and shall progress toward the sumps, shoving and displacing water as the placement progresses.
2. When the water elevation cannot be maintained as specified in paragraph 1, the Contractor will be required to place a concrete foundation seal of the dimensions necessary. This seal shall be considered as a sub-footing and shall be placed below the bottom of footing as shown on the plans or as determined by the Engineer.

Dewatering of the foundation seal may proceed when the concrete is sufficiently strong to withstand the hydrostatic pressure. After dewatering, all laitance or other unsatisfactory material on the top of the seal shall be removed by scraping, chipping or other means.

Pumping from the interior of any foundation enclosure shall be done to preclude the possibility of the movement of water through any fresh concrete. Pumping will not be permitted during the placing of concrete or for a period of at least twenty-four (24) hours thereafter, unless it can be done from a suitable sump separated from the concrete work by a reasonably water-tight wall or other effective means.

K. Protection of Concrete

The following provisions apply to all concrete in addition to the requirements for curing as set forth in Section 55 Concrete Masonry.

Any concrete placed between November 1 and April 15 shall be covered by insulated blankets or equivalent heat retention methods, unless such requirements are waived by the Engineer.

Concrete for sidewalks, curb and gutter, drop inlets, manholes, ditch checks, pipe headwalls, approach slabs, pavement, etc. shall be maintained above 32°F until it has attained a compressive strength of 1500 psi. The compressive strength will be checked with a Swiss Impact Hammer in accordance with SD 409.

Enclosures for protection of concrete shall be capable of maintaining the temperature specified in the following and shall be of a height that permits free circulation of artificial heat. The use of salamanders or other types of open-flame heating unit is prohibited.

Form insulation shall be bats of fiberglass, rock wool, balsam wool, or similar commercial insulation material. Insulation shall remain in place for the full protection period. The forms may be loosened slightly to control the temperature of the concrete.

The Contractor shall drill holes in the forms and provide thermometer wells one-half inch to one inch in depth where required by the Engineer to determine the temperature of the concrete.

Concrete for bridges, box culverts, retaining walls, anchor blocks, median barriers, light and signal footings, and other structures when indicated on the plans shall be maintained at a temperature of 50°F or above for the first 72 hours after the concrete has been placed. The concrete shall be maintained at a temperature of 40°F or above for the next 48-hour period. In the event lower temperatures are recorded during this protection period, one extra day of protection time at temperatures above 40°F shall be added to the original five days of protection for each day that the minimum concrete temperature falls below the specified temperature.

If an additional bag of cement per cubic yard is used, or if high early strength cement is permitted, the concrete shall be maintained at a temperature of 60°F or above for 72 hours. In the event temperatures less than 60°F are recorded during this protection period, the protection time required shall be increased according to the preceding paragraph, with its provision for low temperatures also being applicable.

Until one of the protection periods have been satisfied, cold weather protection shall continue, false work shall remain in place, live loads shall not be applied, and the concrete temperature shall be maintained above 35°F.

At the end of the protection period, the concrete temperature shall not be permitted to fall more than 40°F for each 24-hour period.

The temperature of concrete that is being protected by means of housing and heating and/or insulated forms shall not exceed 100°F during the protection period.

It will be permissible to flood concrete to a minimum depth of one foot. The water shall be maintained for ten days after the concrete is placed at a temperature, which will prevent freezing of the water in contact with the concrete.

L. Removal of Formwork and Construction of Superimposed Elements

In the determination of the time for the removal of false work and forms, consideration shall be given to the location and character of the structure, the weather, and any other conditions influencing the setting of the concrete.

Methods of false work and form removal likely to cause overstressing of the concrete shall not be used. Supports shall be removed in a manner that permits the concrete to uniformly and gradually take the stresses due to its own weight.

When field operations are not controlled by tests, false work and forms shall not be removed nor superimposed concrete placed without the approval of the Engineer. The following periods are exclusive of days when the temperature is below 40°F.

If field operations are controlled by tests, either cylinders or Swiss hammer, false work and forms may be removed from the affected concrete and placement of superimposed concrete may proceed when such concrete reaches the strength in the following table:

Structural Elements	Removal of Formwork			Placing of Concrete in Superimposed Elements		
	Time	or	Concrete Strength PSI	Time	or	Concrete Strength PSI
Footings	24 hrs.		800	72 hrs.		1600
Columns	24 hrs.		800	12 days		2000
Pier & Bent Caps	15 days		2400	20 days		3000
Abutment & Sills	24 hrs.		800	20 days		3000
Deck Slabs for Concrete Bridges	15 days		2400	48 hrs.		1200
Other Deck Slabs & Top Slab of RCBC	12 days		2000	48 hrs.		1200
Vertical Surfaces not Carrying Load	24 hrs.		800			
Vehicle Surfaces Carrying Load	5 days		2000	10 days		3000

M. Backfilling and Application of Live load

All concrete, except approach slabs, footings, columns, curb and gutter, and sidewalk shall have attained design strength before backfilling or before applying highway live loads. Approach slabs may be open to traffic when a compressive strength of 4000 psi is attained. Footings, columns, curb and gutter, and sidewalks shall not be backfilled until permission has been given by the Engineer.

N. Joints

Joints shall be constructed at the locations and of the dimensions shown on the plans or as directed by the Engineer. In joining fresh concrete to that which has already set at a construction joint, the concrete in place shall have all loose material removed.

O. Curing Concrete

Concrete shall be promptly protected by covering with canvas, straw, burlap, sand, or other satisfactory material and kept moist by flushing or sprinkling with water. Forms remaining in place shall be considered as adequate cover for curing for the number of days such forms remain in place, providing all exposed concrete surfaces are so covered. Curing shall continue for a period of not less than seven days after placing the concrete. Other precautions to insure development of strength shall be taken as the Engineer may direct.

In lieu of the above method of curing, white pigmented membrane curing compound may be used. The compound shall be uniformly applied after the final finishing operations are completed and immediately after the free water has left the surface.

The curing compound may be applied in either one or two applications in accordance with the direction of the manufacturer. If applied in two coatings, the second shall not be applied later than 30 minutes after the first.

Equipment, workers, or materials will not be allowed on the concrete surface for a minimum of seven days after the application of the curing compound, unless the surface is adequately protected with a layer of fine sand or other approved material. Such covering shall not be applied for at least eight hours after application of the curing compound. If, during the seven day curing period, the membrane film is broken or damaged, the areas affected shall be given a duplicate treatment of the curing material, applied at the same rate as the first treatment.

Surfaces, which are to receive a commercial texture finish, shall be cured by a method other than membrane cure. Surfaces, which are to receive a rubbed finish or a brush finish, shall be cured by a method other than membrane cure until the rubbing or brushing has been completed after which the membrane curing may be used as directed above. Membrane curing compound will not be allowed on any surface to which concrete is to be bonded.

Bridge decks, approach slabs, bridge curb, and curb and gutter adjacent to bridges shall be cured as follows:

Bridge curb and curb and gutter shall be cured by a uniform application of Linseed Oil Base Emulsion Curing Compound at the specified rate as soon as final finish operations are completed. When a commercial finish is to be applied, curing shall be accomplished with cotton or burlap mats and polyethylene sheeting.

As soon as bridge deck and approach slab concrete has received the final surface finish, Linseed Oil Base Emulsion Curing Compound shall be uniformly applied at the specified rate. This application is not a substitute for curing with burlap mats and polyethylene sheeting but is required for moisture retention until the burlap mats and polyethylene curing materials can be placed. The burlap mats and polyethylene sheeting curing materials shall be in place not later than 12:00 noon of the day following concrete placement. Concrete surfaces, which are to have superimposed concrete placed upon or against them shall be protected from application of Linseed Oil Base Emulsion Curing Compound and shall be cured with cotton or burlap mats and white polyethylene sheeting. Reinforcing steel shall also be protected from application of Linseed Oil Base Emulsion Curing Compound.

Application of Linseed Oil Base Emulsion Curing Compound shall conform to the following requirements:

1. Prior to application, the material shall be mixed to a uniform consistency without the use of air, violent agitation, or thinning.
2. The material shall be maintained above 50°F during application.
3. The material shall be spray applied with an applicator of sufficient capacity and spray nozzles of proper size and design to provide a uniform application at the specified rate immediately after the concrete has received the final finish.
4. Unless otherwise provided on the plans or ordered by the Engineer, minimum application rate shall be as follows:

Carpet drag or broom finish - one gallon/150 square feet

Steel tine finish - one gallon/125 square feet

Surfaces designated to be cured with cotton or burlap mats and polyethylene sheeting shall be cured in the following manner:

The surface of the concrete to be cured shall be entirely covered with cotton or burlap mats. The mats shall be placed so the entire surface is completely covered with sufficient material beyond the periphery of the area to assure

adequate curing of the edges. The mats shall be thoroughly saturated with water and shall be placed with the wettest side down. As an alternate method of placing the burlap, the deck may be flooded with water, the burlap placed immediately on the flooded deck and the burlap thoroughly saturated in place prior to covering with polyethylene.

Immediately after placement, the mats shall be entirely covered with white polyethylene sheeting. The units used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down to assure intimate contact with the surface covered.

Curing shall be maintained for a period of seven days after concrete has been placed. The mats shall be kept moist by periodic applications of water.

P. Surface Finish

The surfaces of all concrete masonry shall be worked during placing. The working shall force all coarse aggregate from the surface and thoroughly work the mortar against the forms to produce a smooth finish relatively free of water, air pockets, or honeycombing.

As soon as the concrete has set sufficiently, the forms on all exposed surfaces shall be carefully removed, and all depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in the same proportions as the concrete being treated. All fins and rough corners on the surfaces shall be removed to present a neat and uniform appearance.

Additional finishing will be required as follows:

1. Rubbed, Brushed, and Commercial Texture Finishes

One of these three finishes will be required for all railing, curb, parapets, wings and other surfaces not subject to wear, which are visible to the traveling public. A selected finish must be used throughout the entire structure, except the finish for the top and inside of the curb may be different than that used for the other parts of the structure. These finishes will not be required on wing walls and parapets of box culverts and wing walls and backsides of curbs on bridges, which do not have traffic passing beneath them, provided the forms result in a smooth, unblemished surface.

a. Rubbed Finish

As soon as the pointing has set sufficiently, the surfaces to receive a rubbed finish shall be thoroughly wetted with a brush and rubbed with a medium coarse carborundum stone or an abrasive of equal quality using a small amount of mortar on its face. The rubbing shall be continued until all form marks and projections are removed, producing a relatively smooth clean surface free from pits or irregularities.

The final finish shall be obtained by rubbing with a fine carborundum stone or an abrasive of equal quality. This rubbing shall continue until the entire surface has a smooth texture and a uniform color.

b. Brushed Finish

This finish will be permitted only if it is accomplished within 12 hours of concrete placement. The forms shall be removed as soon as the concrete is able to stand firm without slumping. The surface shall be worked with a rubber float, which may be dipped in a very wet three to one (3:1) sand and cement grout mixture. Immediately after the surface is worked into a lather, a soft bristle brush shall be used to smooth the surface, leaving a fine grained, smooth, but sanded texture. A "plastering" job resulting from the use of an excess of grout on the surface will not be permitted.

c. Commercial Texture Finish

This finish shall consist of an application, using a rubber float or approved equal, of latex or acrylic-based bonding agent mixed with a standard or commercial packaged mortar.

The Owner will maintain a list of approved materials and mixes to be used. Unless the bonding agent material and mixture proposed for use is one, which has been previously approved by the Owner, the Contractor shall have the material and mixture tested in a recognized commercial testing laboratory in accordance with procedures prescribed by the Owner. Work in conjunction with the commercial texture finish shall not be started until the material and mixture have been approved.

The mixture shall be applied in sufficient thickness to completely cover the original surface with a one-coat application, but shall not be so thick as to cause runs, sags, or a plastered effect. The final surface after drying shall be uniform in color and texture, with no evidence of laps or breaks in continuity.

Corrective work will be required over areas, which have not been satisfactorily finished, at the Contractor's expense, including as much adjacent area as necessary to provide uniformity of appearance.

Preferably, application of the commercial texture finish shall not be started until other work, which might mar the finish has been completed. Should the Contractor elect to commence with the finishing operation prior to completion of any work that might mar the surface, provisions shall be made to protect the surface. The finishing operation shall be carried on continuously from beginning to completion on any one surface.

2. Float Finish

Unformed surfaces, except bridge decks, shall be given a float finish. After the concrete has been struck off, the surface shall be thoroughly worked and floated with a suitable floating tool of wood, canvas, magnesium, or cork. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.

3. Bridge Deck Finish

The concrete shall be placed slightly higher than the finished surface of the deck. Immediately after the concrete has been placed and consolidated as specified, the surface shall be struck off and finished with an approved finishing machine that meets the following minimum requirements:

The machine shall be a self-propelled rotating cylinder type, with one or more rotating steel cylinders and augers. The machine shall span the concrete placement width. The cylinders and augers shall place and consolidate the concrete to the established profile by traversing the placement width, transverse to the roadway centerline. The machine shall be capable of forward and reverse motion under positive control, with provision for raising all cylinders and augers to clear the surface when traveling in reverse. Modifications to the factory product will require approval by the Engineer. The portion of the deck adjacent to curbs shall be neatly finished to a true surface with a wooden hand float.

Before the concrete has attained its initial set, it shall be given a final finish by transverse brooming or carpet drag to provide a surface micro texture.

The surface of the concrete bridge deck shall be given a metal tine finish. Tined grooves shall be a nominal one-eighth inch deep with effective spacing of three-fourths inch to one inch. Care shall be taken to avoid overlaps of the passes in the tining operation. The 12 inches of the deck next to curb shall be left untined.

After the concrete has hardened, the surface and joints shall be tested with a ten foot straightedge. The permissible longitudinal and transverse surface deviation shall be one-eighth inch in ten feet. Any portion of the deck showing variation from the template of more than one-eighth inch shall be either ground to an elevation that will be within the permissible deviation or be price adjusted, at the discretion of the Engineer. A tool equipped with specially prepared circular diamond blades mounted on a horizontal shaft shall be used when grinding is necessary.

Areas that have been ground shall not be left smooth or polished but shall have a uniform texture equal in roughness to the surrounding unground concrete.

4. Exposed Aggregate Pavement

Exposed aggregate pavement/surfacing shall have an exposed, natural, rounded, river rock finish. This finish may be accomplished by placing a concrete curing retarder material on the surface of the freshly placed concrete. When underlying concrete is sufficiently hardened, the set retarded surface mortar may be removed by flushing with water and a gentle scrubbing with a broom, leaving the underlying aggregate exposed. The surface shall be allowed to dry and a covered with a coat of clear, non-yellowing, UV resistant urethane sealer.

Q. Pre-pour Inspection Requirements for Concrete Bridge Decks

Pre-pour inspections will be conducted for all new concrete bridge decks. The Contractor shall advise the Engineer 24 hours in advance of the time when deck preparation will be complete and ready for inspection. At the time of inspection, the Contractor shall have completed the following items of work:

1. Formwork and decking shall be complete and joints shall have been made mortar tight.
2. Reinforcing steel shall have been accurately placed, secured and tied as per specifications.
3. Screed Rails shall have been set and adjusted for final grade.
4. Finishing machine shall have been adjusted for crown slope and placed upon the screed rails.
5. Necessary walkways and safety railing shall have been installed.
6. A responsible employee of the Contractor shall have been designated to accompany the Engineer during the pre-pour inspection.

Following the pre-pour inspection, any work, which should be completed before deck pouring operations begin, shall be completed during the Contractor's normal work shift. Preparation work shall not extend into the late evening hours. Violation of this provision will be cause to postpone the scheduled deck placement as directed by the Engineer.

R. Concrete Quality Tests

The Contractor is to be responsible for slump, air content, seven and twenty-eight day compressive strength test sets. All sampling and testing shall be done by certified testing laboratory personnel.

Testing shall be done at the rate of one test set per maximum 30 cubic yards of concrete placed. All test results shall be submitted to the Engineer prior to final payment. The Engineer or his representative shall be present for all field sampling.

55.4 METHOD OF MEASUREMENT

Concrete masonry will be measured in accordance with the neat line dimensions shown on the plans, unless changes are ordered in writing during construction.

Volumes of concrete masonry will be computed to the nearest one-tenth cubic yard. Deductions will not be made for the volume of concrete occupied by utility conduit, six inch or smaller drainage pipe, reinforcing steel, encased structural steel, pile heads, anchors, sleeves, and encased grillage, or for volume of concrete displaced by weep holes, joints, drains and scuppers, or for fillets, chamfers or scorings, one inch square or less in cross-section.

Concrete used for foundation seals will not be measured for payment.

Concrete approach and sleeper slabs will be measured to the nearest one-tenth square yard.

55.5 BASIS OF PAYMENT

The accepted quantities of concrete masonry will be paid for at the contract price per cubic yard to the nearest one-tenth cubic yard.

Concrete approach and sleeper slabs will be paid for at the contract unit price per square yard to the nearest one-tenth square yard.

Payment will be full compensation for materials, labor, equipment and tools necessary, including concrete, reinforcing steel, joint sealer, plastic sheeting, preformed expansion joint material, sawing, testing, and incidentals.

END OF SECTION

SECTION 56

CONCRETE FOR INCIDENTAL CONSTRUCTION (CLASS M)

56.1 DESCRIPTION

A. General

This work consists of site preparation, form construction, and the furnishing, handling, placing, curing, and finishing of Class M concrete for minor structures and incidental construction.

B. Related Work

Section 55	Concrete Masonry
Section 57	Reinforcement for Concrete Masonry
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand-
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 108	Concrete Curing Materials
Section 113	Prefomed Expansion Joint Filler for Concrete
Section 114	Concrete Joint Sealer
Section 123	Reinforcement

56.2 MATERIALS

A. Cement

Cement shall conform to the requirements of Section 100. Unless otherwise specified, Type II cement shall be used.

B. Fine Aggregate

Fine Aggregate shall conform to the requirements of Section 105.

C. Coarse Aggregate

Coarse Aggregate shall conform to the requirements of Section 107.

D. Water

Water shall conform to the requirements of Section 104.

E. Admixtures

Admixtures shall conform to the requirements of Sections 101 and 102.

F. Reinforcing Steel

Reinforcing Steel shall conform to the requirements of Sections 57 and 123.

G. Curing Materials

Curing Materials shall conform to the requirements of Section 108 and shall be white pigmented.

H. Joint Filler

Joint Filler shall conform to the requirements of Section 113.

I. Joint Sealer

Joint Sealer shall conform to the requirements of Section 114.

56.3 CONSTRUCTION REQUIREMENTS

The supplier of Class M Concrete will be required to furnish a written statement certifying that the concrete furnished meets the applicable requirements of Section 56 for Class M-5 or M-6 concrete.

A. Concrete Quality and Proportion

Class M concrete will be designated on the plans as Class M-5 Concrete or Class M-6 Concrete. If no designation is given, it shall be assumed to be M-6 Concrete. M-5 concrete is acceptable only for special applications with written approval of the Engineer.

When Class M-5 concrete is designated, the following requirements shall apply:

1. The concrete aggregate mixture shall contain a minimum of fifty percent (50%) coarse aggregate by weight.
2. The mixture shall contain at least five hundred (500) pounds of cement per cubic yard.

3. The minimum twenty-eight (28) day compressive strength shall be three thousand (3000) psi.

When Class M-6 concrete is designated, the following requirements shall apply:

1. The concrete aggregate mixture shall contain a minimum of fifty percent (50%) coarse aggregate by weight.
2. The mixture shall contain at least six hundred (600) pounds of cement per cubic yard.
3. The minimum twenty-eight (28) day compressive strength shall be four thousand (4000) psi.

Class M-5 and M-6 concrete shall conform to the following slump and entrained air requirements:

1. The slump at time of placement shall not exceed four and one half (4 ½) inches.
2. The concrete destined to experience repeated freeze and thaw cycles shall contain between four and five tenths percent (4.5%) and seven and five-tenths percent (7.5%) entrained air. Air shall be, entrained by an approved air-entraining admixture. Where the concrete is not required to experience freeze-thaw and is to receive a burnished finish, air entrainment add mixtures shall be deleted from the mix.

B. Equipment

1. Batching, mixing, and hauling equipment shall be to the satisfaction of the Engineer.
2. Wood and metal forms shall meet the requirements of Section 55.

C. Handling, Measuring, and Batching Materials

Handling, measuring, and batching materials shall be to the satisfaction of the Engineer.

D. Mixing Concrete

Concrete shall be mixed to the satisfaction of the Engineer.

E. Limitations of Mixing

Limitations of mixing shall conform to Section 55.

F. Concrete Delivery Requirements

Concrete delivery requirements shall conform to Section 55.

G. Concrete Placing Requirements

Concrete placing requirements shall conform to Section 55. Placement of concrete on a frozen surface or frost of any depth will not be permitted.

H. Depositing Concrete in Water

Depositing concrete in water shall conform to the requirements of Section 55.

I. Protection of Concrete

Unless otherwise provided on the plans or other contract documents, concrete shall be maintained above thirty-two (32) degrees F. until it has attained a compressive strength of one thousand five hundred (1500) psi as determined by a properly calibrated maturity meter or by compressive cylinder testing.

J. Removal of formwork, construction of superimposed elements, backfilling, and application of live loads shall be as approved by the Engineer.

K. Joints

Joints shall be constructed as per Section 55.

L. Curing Concrete

Curing concrete shall conform to the requirements of Section 55.

M. Surface Finish

Surface finish shall conform to the requirements of Section 55.

56.4 METHOD OF MEASUREMENT

Class M concrete shall be measured in accordance with neat line dimensions shown on the plans, unless changes are ordered during construction. Volumes will be computed to the nearest one-tenth (0.1) cubic yard.

Deductions will not be made for concrete displaced by pipes or conduits less than six (6) inches in diameter, reinforcing and structural steel, weep holes, joints, drains and chamfers or fillets less than one square inch in cross section.

56.5 BASIS OF PAYMENT

The accepted quantity of Class M concrete will be paid for at contract unit price per cubic yard to the nearest tenth (0.1) cubic yard.

Payment will be full compensation for labor, equipment, materials, and incidentals not paid for under a separate item, required to furnish Class M concrete in place.

END OF SECTION

SECTION 57

REINFORCEMENT FOR CONCRETE MASONRY

57.1 DESCRIPTION

A. General

This work consists of furnishing and placing steel of the specified size and type, epoxy coating where required, as reinforcement in concrete masonry.

B. Related Work

Section 55	Concrete Masonry
Section 100	Portland Cement
Section 123	Reinforcement

57.2 MATERIAL

Reinforcement and epoxy coating of reinforcing bars shall conform to the requirements of Section 123. Reinforcement shall be furnished in the full lengths indicated on the plans.

57.3 CONSTRUCTION MATERIALS

A. Protection of Material

Steel reinforcement shall be protected from injury and, when placed in the work, it shall be free from dirt, detrimental scale, paint, oil, and other foreign substances.

B. Bending

The reinforcement shall be bent to the shapes shown on the plans. Bending and bundling shall conform to the standard practice currently specified by the Concrete Reinforcing Steel Institute.

C. Placing and Fastening

Reinforcing steel shall be accurately placed and firmly held in the positions shown on the plans using chairs or other approved methods. Bars shall be tied at all intersections except where spacing is less than one (1) foot in each direction, in which case, alternate intersections shall be tied.

In addition to the requirements for tying bars at intersections, the top mat of bridge slab reinforcing steel shall be tied down with sixteen (16) gage minimum tie wires or other devices approved by the Engineer. Ties shall be plastic-coated when used in

conjunction with epoxy-coated reinforcing steel. Chairs, bolsters, supports, and clips for coated bars shall be plastic or completely epoxy- or plastic-coated. The Contractor may propose other devices for the approval of the Engineer.

On girder bridges, ties shall be used along each line of beams at longitudinal intervals not to exceed eight (8) feet. Where practical, the ties shall be secured to the shear transfer devices protruding from the top of the beam. Where shear transfer devices are not available, the ties may be secured to the bottom mat of slab reinforcing steel.

Other types of bridges shall have the top mat of reinforcement tied down at a maximum of twelve (12) foot longitudinal and transverse intervals with the ties secured to either the forms or bottom mat of slab reinforcing steel.

Distances from the forms shall be, maintained by stays, blocks, ties, hangers, or other supports approved by the Engineer. Devices for holding reinforcement from contact with the forms shall be of approved shape and dimensions. Layers of bars shall be, separated by metal devices approved by the Engineer. The use of pebbles, stone, brick, metal pipe, and wooden blocks will not be permitted for this purpose. It will not be permissible to tack weld reinforcement. Reinforcement in any member shall be inspected and approved by the Engineer before the placing of concrete begins.

The placing of any reinforcement except wire mesh during the process of placing the concrete will not be permitted. Concrete placed in violation of this provision may be rejected and ordered removed.

57.4 METHOD OF MEASUREMENT

Where a bid item for reinforcement for concrete masonry is provided in the Bidder's Proposal, such will be measured to the nearest pound, based on the theoretical number of pounds complete in place as shown on the plans or as ordered by the Engineer. The weights calculated shall be based upon the following table:

Size	1/4"	#3	#4	#5	#6	#7	#8	#9	#10	#11	
	.167	.376	.668	1.043	1.502	2.044	2.670	3.40	4.303	5.313	Lbs./LF

Allowance will not be made for the clips, wire, or other fastening devices for holding the steel in place.

Where no bid item for reinforcement is included, no measurement will be made.

57.5 BASIS OF PAYMENT

Reinforcement for Concrete Masonry and Epoxy-Coated Reinforcement for Concrete Masonry will be paid for at their contract unit prices per pound to the nearest whole pound.

Where no such bid item is included, such cost shall be incidental to the various masonry items.

END OF SECTION

SECTION 58

PRECAST CONCRETE BOX CULVERT

58.1 DESCRIPTION

A. General

This work consists of furnishing and installing Pre-cast Concrete Box Culverts.

B. Related Work

Section 51	Structure Excavation for Box Culvert
Section 52	Box, Pipe, and Plate Culvert Undercutting
Section 53	Drainage Fabric Protection for Reinforced Concrete Box Culvert
Section 54	Pipe Culverts
Section 108	Concrete Curing Materials
Section 200	Controlled Low strength Material
Section 202	Engineering Fabric

58.2 MATERIALS

Pre-cast Concrete Box Culvert materials design and fabrication shall conform to the requirements of AASHTO M 259 or M 273, except as modified on the plans and by this Specification. Configurations in variance with those provided by AASHTO will be accepted provided the AASHTO materials, design and fabrication specification requirements and requirements of this Specification are complied with.

- A. End Section (inlet or outlet) materials, design and fabrication shall conform to the requirements of AASHTO Standard Specifications for Highway Bridges and Materials Specifications.
- B. Drainage Fabric shall conform to the requirements of Section 202.
- C. Polyethylene Sheeting shall conform to the requirements of Section 108.
- D. Steel wire bar supports, in contact with the casting forms, shall be stainless steel, hot dipped galvanized or plastic tipped extending at least one-half (1/2) inch from the form surface.

58.3 CONSTRUCTION REQUIREMENTS

A. Design

1. Pre-cast Box Culverts shall be designed to satisfy load conditions shown on the plans.

The design shall conform to the AASHTO design requirements for the depth of fill, including surfacing, etc., as well as live load or loading indicated on the plans. The specified live load shall apply to all barrel sections.

2. Prior to fabrication of box culvert sections, the Contractor shall furnish, for Engineering Division review, shop drawings and a checked design. The drawings shall be complete and comprehensive and show all reinforcing steel, its placement, configuration, and total quantities for the complete structure.

A checked design for barrel sections will not be required to be submitted if the proposed fabrication dimensions and reinforcement conform to AASHTO M 259 or M 273. A checked design for end sections will be required.

B. Fabrication

1. The minimum length of pre-cast sections shall be four (4) feet.
2. Joint ties as detailed on the plans shall be provided on all sections.
3. Steel wire bar supports shall be used to maintain proper reinforcement location and concrete cover. Cutting of reinforcement and bending to the form surface, for support, will not be permitted.
4. Welding of reinforcing steel will not be permitted.

C. Installation

1. Foundation preparation shall be in accordance with Sections 51, 52, and 54.
2. The foundation shall be shaped to provide the template section and uniform density, satisfactory to the Engineer.
3. The floor joint between adjacent sections shall be sealed with pre-formed mastic. A strip of drainage fabric shall be placed along the wall and sides to provide a minimum of two and one-half (2 1/2) feet of fabric centered on the joint. Where required, transverse joints in the fabric shall be accomplished by overlapping the fabric at least two (2) feet. Polyethylene sheeting shall be placed between the fabric and the pre-cast box culvert. Sufficient adhesive will be permitted along the edge of the fabric and polyethylene sheeting to hold it in place during backfilling. Lift holes shall be covered or plugged.
4. Each section shall be tied to adjacent sections with joint ties as detailed on the plans.

5. Backfilling shall conform to the requirements of Section 54. Hand compaction methods or use of flowable fill may be required for satisfactory compaction under and adjacent to corners with a radius and between culverts on multiple installations.

D, Precast Concrete Box Culvert Tests:

1. General: A visual inspection and/or a television inspection test shall be performed as specified herein for all precast concrete box culvert(s) (box culvert(s)) as a condition of acceptance by the City. The Engineer shall determine whether a visual test or television test or both tests will be required. All tests shall be performed after backfill is complete but prior to any surface restoration.
2. Pre-Cleaning: Prior to testing newly installed precast concrete box culverts the Contractor shall remove all accumulated construction debris, rock, gravel, sand, silt, and other foreign matter from the precast concrete box culvert.

The Contractor shall be responsible for all work necessary to make the precast concrete box culvert acceptable for usage including removal of all mud, silt, rocks, or blockages that make said box culverts unacceptable for final acceptance and usage. Also included is all cleanup work required prior to final acceptance.

The City will not be responsible for cleaning box culverts prior to the visual inspection and televising the box culvert. In the event that the box culvert is not acceptable for visual inspection or televising, due to the Contractor's operations, the Contractor will be notified. It will be the Contractor's responsibility to arrange to clean the box culvert and make it acceptable for the visual inspection or television work. If not cleaned in a timely manner, the City may cause to take any actions necessary and charge the Contractor one and a half (1½) times the cost incurred.

3. Tests: All newly installed box culverts shall pass a visual inspection by the Engineer and/or a television inspection by the City Utility Maintenance Division. The visual and/or television inspection shall consist of viewing the inside of all box culverts installed to determine proper alignment, grade, joining, etc. The Contractor shall correct, at his own expense, any defects discovered from the visual and/or televising inspection.

A visual and/or television inspection shall be completed unless specified otherwise in the Detailed Specifications or on the Drawings. Waiving the visual and/or television inspections shall only be done in writing by the Engineer and will only be considered if requested by the design engineer.

The expense of the initial visual and/or television inspection and one additional reinspection will be borne entirely by the City. If defective workmanship of material or construction is noted, the Contractor at no expense to the City, shall

correct the deficiency. The City will perform additional visual and/or television inspections to review if the repairs were made properly and in accordance with the specifications. The expense of any additional visual and/or television inspections beyond the initial inspection and one additional reinspection will be borne entirely by the Contractor. The Contractor shall be responsible for all related costs, including concrete or asphalt resurfacing if the street has been surfaced. The Contractor shall be required to repair all deficiencies. The City may cause to take any actions necessary for any items not completed or repaired in a timely manner and may charge the contractor one and a half (1½) times the costs incurred.

It is the Contractors responsibilities to notify both the Engineer/City Inspector and Utility Maintenance that the box culvert is ready for inspection. From the time initial notification that the box culvert is ready to be inspected the Contractor shall allow the City at least four (4) weeks to perform the visual and/or television inspections. Any surfacing started prior to visual and/or televising the box culvert and said box culvert being accepted is at the Contractors own risk.

58.4 METHOD OF MEASUREMENT

A. Furnishing Pre-cast Box Culvert

Furnishing pre-cast box culverts will be measured by the linear foot of box culvert furnished and accepted, excluding end sections. The footage shall be obtained by multiplying the nominal length of the sections by the number of sections furnished and accepted and rounding to the nearest whole foot.

B. Installing Pre-cast Box Culvert

Installing pre-cast box culvert will be measured by the linear foot. The footage shall be obtained by multiplying the nominal length of sections by the number installed.

C. Furnishing Pre-cast Box Culvert End Sections

Furnishing pre-cast box culvert end sections will be measured per each of end sections furnished and accepted.

D. Installing Pre-cast Box Culvert End Sections

Installing pre-cast box culvert end sections will be measured per each of end sections installed and accepted.

58.5 BASIS OF PAYMENT

A. Furnishing Pre-cast Box Culvert

Furnish pre-cast box culvert will be paid for at the contract unit price per linear foot to the nearest whole foot of pre-cast box culvert furnished and accepted.

Payment for this item will be full compensation for furnishing the box culvert, joint seal mastic, drainage fabric, polyethylene sheeting, and joint ties.

B. Installing Pre-cast Box Culvert

Installing pre-cast box culvert will be paid for at the contract price per linear foot to the nearest whole foot of pre-cast box culvert installed and accepted.

Payment for this item will be full compensation for pre-cast box culvert installation and will include compensation for foundation preparation, backfilling, testing, and all other work incidental to the installation.

C. Furnishing Pre-cast Box Culvert End Sections

Furnishing pre-cast box culvert end sections will be paid for at the contract unit price for each end section accepted.

D. Installing Pre-cast Box Culvert End Sections

Installing pre-cast box culvert end sections will be paid for at the contract unit price for each end section accepted.

END OF SECTION

SECTION 59

STEEL BEAM GUARD RAIL

59.1 DESCRIPTION

A. General

This work consists of furnishing and construction steel beam guardrail.

B. Related Work

Section 19 Incidental Work
Section 126 Wood Preservatives and Preservative Treatments

59.2 MATERIALS

A. Wood Posts and Offset Blocks

Wood posts and offset blocks shall be Douglas fir or Pine from sound seasoned stock. Posts and blocks shall be treated as set forth in Section 126. Posts and blocks with checks or cracks more than one-fourth (1/4) inch wide and deeper than three (3) inches will not be acceptable.

B. Steel Beam Guard Rail

Steel beam guardrail shall be Type conforming to the requirements of AASHTO M 180.

C. Castings

Castings shall conform to the requirements of ASTM A47.

59.3 CONSTRUCTION REQUIREMENTS

A. Posts shall be set plumb at the correct alignment in holes dug to the size specified and backfilled with satisfactory filling material compacted in layers.

B. In lieu of the above requirements, post may be set by driving. Driving shall be accomplished by mechanical means, which will give the necessary accuracy of placement without any damage.

C. Posts and rail shall be set using a string line or other method approved by the Engineer.

- D. Sub-grade shall be prepared and graded to the lines and grades shown on the plans and details. Grading will be incidental to Steel Beam Guard Rail and Breakaway Terminal End Sections.
- E. Guard rail reflectors shall be provided at all post locations for all new and temporary guardrails used. Reflectors will be incidental to Steel Beam Guard Rail.

59.4 METHOD OF MEASUREMENT

A. Steel Beam Guard Rail

Each class and type, (curved or straight) will be measured by the linear foot along the centerline of the rail. The length in feet shall be understood to be the overall length center to center of end posts or to connections with bridges and culverts.

B. Breakaway Cable Terminal End Sections

The quantity of Breakaway Cable Terminal end sections will be the actual number installed and accepted.

59.5 BASIS OF PAYMENT

- A. Steel Beam Guard Rail will be paid for at the contract unit price per linear foot to the nearest whole foot for each class and type installed. Payment will be full compensation for materials, labor, equipment, and incidentals required.
- B. Breakaway Cable Terminal End Sections will be paid for at the contract unit price for each end section installed. Payment will be full compensation for materials, labor, equipment, and incidentals required.

END OF SECTION

SECTION 60

CONCRETE CURB AND GUTTER

60.1 DESCRIPTION

A. General

This work consists of constructing concrete curb and gutter on a prepared subgrade.

B. Related Work

Section 12	Roadway and Drainage Excavation
Section 55	Concrete Masonry
Section 56	Concrete for Incidental Construction, Class M
Section 57	Reinforcement for Concrete Masonry
Section 61	Concrete Sidewalk and Handicap Ramps
Section 62	Drop Inlets
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 108	Concrete Curing Materials
Section 113	Preformed Expansion Joint Filler For concrete
Section 114	Concrete Joint Sealer
Section 117	Aggregate for Granular Bases and Surfacing
Section 123	Reinforcement

60.2 MATERIALS

- A. Concrete shall conform to the requirements of Class M6, Section 56.
- B. Expansion joint filler shall conform to the requirements of Section 113.
- C. Curing compound shall conform to the requirements of Section 108, Linseed Oil Base Emulsion Compound, white pigmented.
- D. Reinforcing steel shall conform to the requirements of Section 123.

60.3 CONSTRUCTION REQUIREMENTS

A. General

The construction of fillets and curb and gutter shall follow the construction of inlet boxes and precede the construction of bituminous surfacing. Inlet tops shall be constructed with the curb and gutter to provide a continuous grade and alignment.

Monolithic curb, gutter, and pavement may be placed providing a sawed longitudinal joint is constructed at the theoretical edge of the pavement and the gutter cross-slope is as shown for standard curb and gutter.

The foundation shall be excavated, shaped and compacted to a firm, uniform bearing surface, conforming to the planned section and established grade. Unsuitable foundation material shall be removed and replaced as directed.

Granular material, shall be furnished, placed and compacted to the required Contract depth and density. Minimum depth of granular material placed under fillets, pans, curb and gutter, type "P" gutter, and driveway approach pavement shall be four (4) inches. The foundation shall be thoroughly moistened immediately prior to the placing of concrete.

Forms shall be full depth, rigid, unyielding and mortar tight. They shall be securely staked, braced and tied to the required line and grade.

In lieu of construction using fixed side forms, concrete may be placed and formed to the required shape by using an approved type of extrusion machine. When machine placement is used, the Engineer may permit modification of consistency requirements.

The exposed surfaces of the fillets and pan and curb and gutter shall be finished smooth and even. Edges of gutter and the top face edges of the curb shall be finished with an approved finishing tool. The top surface of the concrete shall be brushed or broomed to slightly roughen the surface and remove the finishing tool marks.

All honeycombed surfaces shall be corrected to the satisfaction of the Engineer by using a grout composed of one part cement and two parts sand. Severly honeycombed areas shall be removed and replaced at the Contractor's expense.

Joints shall be constructed at the locations and of the dimensions shown on the plans or as directed by the Engineer. As a minimum, joints shall match those in the Portland cement concrete pavement section as applicable.

Concrete shall be protected and cured in accordance with the provisions of Section 55.

After the curing period, the area behind the curb and gutter and fillets shall be filled to the required elevations with suitable material and the material shall be satisfactorily compacted. Injury to the concrete shall not occur during these operations. Curb and gutter and fillets shall be backfilled and compacted prior to placing pavement section if applicable.

B. Testing

The Contractor shall be responsible for providing a minimum of a slump, air content, seven (7) day and twenty-eight (28) day compressive strength quality test set for each days pour. Additional test sets and testing may be required by the Engineer or as called for in the Detailed Specifications.

60.4 METHOD OF MEASUREMENT

Concrete curb, gutter and combined curb and gutter will be measured to the nearest one-tenth (0.1) linear foot. Measurement for concrete curb will be on the inside bottom face of the curb. Measurement for separate gutters and combined curb and gutter will be on the inside edge next to the pavement.

Measurement of curb and combined curb and gutter will include tapers for approaches and or entrances. Measurement for approach gutter or "P" gutter will not include tapers.

Measurement for curb and gutter shall not include the "gutter throat" of a Type "E" Inlet or the fillet curb. Refer to standard detail.

Concrete fillets, pans, approach pavement and similar items shall be measured to the nearest whole square foot or square yard consistent with the appropriate bid item in the Bidder's Proposal.

Measurement for granular materials placed under the concrete shall be in accordance with Section 117, Aggregates for Granular Bases and Surfacing.

60.5 BASIS OF PAYMENT

Concrete curb, gutter and combined curb and gutter will be paid for at the contract unit prices per linear foot for the types constructed.

Concrete fillets, pans, approach pavement and similar items will be paid for at the contract unit prices per square foot or per square yard for the types constructed.

Payment for granular materials placed under the concrete shall be in accordance with Section 117, Aggregates for Granular Bases and Surfacing.

Payment for these items will be full compensation for furnishing materials, the expansion joints, steel reinforcement, forms, bracing, excavation, backfill, labor, equipment, and incidentals necessary.

END OF SECTION

SECTION 61

CONCRETE SIDEWALK, HANDICAP RAMPS AND DETECTABLE/TACTILE WARNING SURFACES

61.1 DESCRIPTION

A. General

This work consists of constructing sidewalks, handicap access ramps, detectable tactile warning surfaces, Type "C" retaining wall/sidewalk and exposed aggregate sidewalk on a prepared subgrade.

B. Related Work

Section 55	Concrete Masonry
Section 56	Concrete for Incidental Construction, Class M
Section 57	Reinforcement for Concrete Masonry
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 108	Concrete Curing Materials
Section 113	Preformed Expansion Joint Filler for Concrete
Section 114	Concrete Joint Sealer
Section 117	Aggregates for Granular Bases and Surfacing
Section 123	Reinforcement

61.2 MATERIALS

- A. Concrete for sidewalk shall conform to the requirements of Class M6 Concrete provided in Section 56. Concrete for exposed aggregate sidewalk shall meet the general requirements of Class M6 Concrete except that the large aggregate shall be clean, rounded river rock.
- B. Expansion joint filler shall conform to the requirements of Section 113.
- C. Cushion material shall consist of quarry, rock, gravel or sand, crushed or screened to eliminate material retained on a three-fourths (3/4) inch sieve. The material shall also be free from roots, sod, lumps of dirt, and other deleterious material. Not more than twenty-five percent (25%) by weight shall pass a No. 200 sieve.

- D. Curing compound shall conform to the requirements of Section 108, except that for exposed aggregate sidewalk, normal curing compound shall be deleted and the exposed aggregate surface shall be protected with a mineral solvent or petrochemical solvent based, clear, high gloss acrylic concrete sealer.
- E. Concrete joint sealer shall conform to the requirements of Section 114.
- F. Concrete reinforcing steel shall conform to the requirements of Section 57 and Section 123.
- G. Detectable/Tactile Warning Surfaces shall be Vitriified Polymer Composite (VPC) Cast-in-Place Detectable/Tactile Warning Surface Tile, Armor Tile as manufactured by Engineering Plastics, Inc., ADA Solutions, or approved equal.

Color: Yellow conforming to Federal Color No. 33538. Color shall be homogeneous throughout the tile.

61.3 CONSTRUCTION REQUIREMENTS

A. General

The foundation shall be excavated, shaped, and compacted to a firm, uniform, bearing surface conforming to the planned section and established grade. Unsuitable foundation material shall be removed and replaced as directed. The foundation shall be thoroughly moistened immediately prior to the placing of concrete.

Cushion material shall be placed under the sidewalk to a depth of two (2) inches and satisfactorily compacted.

Forms shall be made of wood not less than two (2) inches nominal thickness or of steel of equal rigidity. Flexible strips may be used on curves. The forms shall be securely held to line and grade and shall not deviate more than one-eighth (1/8) inch from an accurate template ten (10) feet in length. The forms shall remain in place for not less than twelve (12) hours after concrete placement.

Joints shall be formed at intervals equal to sidewalk width by means of a grooving tool, to a depth of at least one-fourth (1/4) the thickness of the sidewalk. Joints and edges shall be finished with an approved one-fourth (1/4) inch edging tool.

Expansion joints with bituminous sealant shall be constructed: at the rate of one joint per 100 foot of length; at the locations and of the dimensions shown on the plans; or as directed by the Engineer.

Immediately after the water sheen has disappeared, the concrete shall be brushed or broomed in a direction perpendicular to the flow of traffic to roughen the surface and remove tool marks. Handicapped access ramps shall receive a medium tined

texture in addition to the broomed finish. Such tined texture shall be placed perpendicular to the slope. (See Detailed Drawings)

Concrete sidewalk shall be protected and cured in accordance with Section 55.

After the curing period, the area adjacent to new sidewalk shall be filled to the required elevation with suitable material and the material shall be satisfactorily compacted, seeded, or sodded.

Colored or stamped concrete or similar forms of architectural concrete finish shall not be placed with in the street right of way, except as specified by the Engineer.

B. Testing

The Contractor shall be responsible for providing a minimum of one set of slump, air content, seven (7) and twenty-eight (28) day compressive strength quality tests for each day's pour. Additional test sets or testing may be required by the Engineer or as called for in the Detailed Specifications.

C. Detectable/Tactile Warning Surface

Installation of detectable/tactile warning surfaces shall be per manufacturers installation instructions.

61.4 METHOD OF MEASUREMENT

Concrete sidewalk and handicap access ramp will be measured to the nearest one-tenth (0.1) linear foot and the area computed to the nearest square foot.

Concrete Type "C" retaining wall will be measured to the nearest one-tenth (0.1) linear foot.

Detectable/tactile warning surfaces will be measured to the nearest square foot.

61.5 BASIS OF PAYMENT

Concrete sidewalk and handicap access ramp will be paid for at the contract unit price per square foot for concrete sidewalk or handicap access ramp, exclusive of sidewalk associated with Type "C" wall.

Concrete Type "C" retaining wall will be paid for at the contract unit price per linear foot of wall for each height specified. Such payment shall include the adjacent sidewalk.

Payment for this item will also be full compensation for labor, equipment, tools, backfilling, furnishing, preparing, testing, and placing materials and incidentals

necessary, including disposal of excavation and discarded materials. Such payment shall include cushion material.

Detectable/tactile warning surfaces will be paid for at the contract unit price per square foot furnished and installed.

END OF SECTION

SECTION 62

DROP INLETS

62.1 DESCRIPTION

A. General

This work consists of furnishing materials and the construction of drop inlets. See also Detailed Drawings.

B. Related Work

Section 54	Pipe Culverts
Section 55	Concrete Masonry
Section 56	Concrete for Incidental Construction (Class M)
Section 57	Reinforcement for Concrete Masonry
Section 63	Storm Sewer Manholes
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 108	Concrete Curing Materials
Section 113	Preformed Expansion Joint Filler for Concrete
Section 114	Concrete Joint Sealer
Section 120	Reinforced Concrete Pipe
Section 121	Corrugated Metal Pipe
Section 123	Reinforcement

62.2 MATERIALS

- A. Concrete shall meet the requirements of Section 55.
- B. Castings - Frames and gratings shall consist of approved gray iron castings meeting the requirements of AASHTO M105, Class 30, for material and to the detailed plan drawings for dimensions and weights. Gratings shall fit the frames with which they are to be used. Inaccuracies of bearing shall be corrected by machining or grinding before use or replaced with new assemblies.
- C. Steel reinforcement shall conform to the requirements of Section 123. All reinforcing steel used in the construction of drop inlets shall be epoxy coated.

- D. Mortar shall consist of one (1) part Portland Cement and two (2) parts mortar sand conforming to Sections 100 and 106 respectively.
- E. Curing compound shall conform to the requirements of Section 108.

62.3 CONSTRUCTION REQUIREMENTS

Type "E" inlets shall be cast in-place and precasting of Type E inlets is not permitted. Special Type "B" and Type "B" inlets maybe precast with prior authorization of the Engineer. A requirement to precasting Special Type "B" and Type "B" inlets will be the submission of precasting details (shop drawings) and reinforcement inspections by the Engineer prior to placement of concrete.

Concrete for drop inlets shall be proportioned, mixed, hauled, and placed in accordance with Section 55.

When the foundation for a drop inlet is in new embankment, the embankment shall be constructed to an elevation at least one (1) foot above the footing before the foundation for the drop inlet is prepared. The foundation shall be compacted to the satisfaction of the Engineer.

The foundation excavated for drop inlets shall be thoroughly moistened immediately prior to the placing of the concrete.

Epoxy coated steel reinforcement shall be placed in accordance with Section 57.

Castings shall be set in full mortar beds or secured as shown on the plans. Castings shall be set accurately to the correct elevation so subsequent adjustment will not be necessary.

Inlet and outlet pipe connections shall be of the same size and kind and shall meet the same requirements as the pipe they connect. Unless otherwise permitted by the Engineer, pipe sections shall be flush on the inside of the structure wall and project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the pipe.

The finished surface of the concrete shall present a neat and smooth appearance. Concrete shall be protected and cured in accordance with Sections 55, except the minimum curing time before removing forms may be reduced to seventy-two (72) hours. The other provisions regarding curing time shall be maintained.

Upon completion and curing of the unit, the sheeting, bracing, forms, and falsework shall be removed and the excavation backfilled. The unit shall not be backfilled until the completion of the 72 hour curing period, or until the concrete reaches a minimum compressive strength of 3000 psi. Backfill shall be placed in layers not exceeding six (6) inches thick and compacted to the same degree as specified for the adjacent

embankment. Installations shall be finished and left in a neat appearing condition satisfactory to the Engineer.

Pipe culverts and storm drains (storm sewers) shall be tested in accordance with the provisions contained in Section 54 – Pipe Culverts.

62.4 METHOD OF MEASUREMENT

As provided in the contract, drop inlets will be measured on a per each basis. The “gutter throat” for Type “E” Inlets will be measured as curb and gutter.

62.5 BASIS OF PAYMENT

When payment for drop inlets is made on a per each basis, payment will be full compensation for furnishing cast-iron frames and gratings, concrete, reinforcing steel, labor, equipment, and incidentals necessary. The “gutter throat” for Type “E” Inlets will be paid for as curb and gutter.

END OF SECTION

SECTION 63

STORM SEWER MANHOLES

63.1 MANHOLES

A. General

This work consists of the construction or reconstruction of manholes.

B. Related Work

Section 54	Pipe Culverts
Section 55	Concrete Masonry
Section 56	Concrete for Incidental Construction (Class M)
Section 57	Reinforcement for Concrete Masonry
Section 62	Drop Inlets
Section 100	Portland Cement
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand
Section 120	Reinforced Concrete Pipe
Section 121	Corrugated Metal Pipe
Section 200	Controlled Low Strength Material

63.2 MATERIALS

- A. Concrete shall conform to the requirements of Class M6, Section 56.
- B. Precast manhole units shall conform to the requirements of ASTM-C-478.
- C. Castings: Frames and covers shall consist of approved gray iron castings meeting the requirements of AASHTO M105, Class 30.
- D. Mortar shall consist of one (1) part Portland Cement and two (2) parts mortar sand conforming to Sections 100 and 106, respectively.

63.3 CONSTRUCTION REQUIREMENTS

Concrete for cast-in-place manholes shall be proportioned, mixed, hauled, and placed in accordance with Section 55.

When the foundation for a manhole is in new embankment, the embankment shall be constructed at least one (1) foot above the footing before the foundation is prepared. The foundation shall be compacted to the satisfaction of the Engineer.

Castings shall be set in full mortar beds or secured as shown on the plans. Castings shall be set to the correct elevation so subsequent adjustment will not be necessary.

Inlet and outlet pipe connections shall be the same size and kind and shall meet the same requirements as the pipe they connect. Unless otherwise permitted by the Engineer, pipe sections shall be flush on the inside of the structure wall and project outside for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the pipe.

Upon completion and curing of the cast in place unit, sheeting, bracing, forms, and falsework shall be removed and the excavation backfilled. Pre-cast units shall be placed on a minimum of four (4) inches of bedding material. Backfill of either type shall be placed in layers not exceeding six (6) inches thick and compacted to the same degree as specified for adjacent embankment except, if Flowable Fill is utilized to backfill, the Flowable Fill shall be placed in accordance with Section 200 – Controlled Low Strength Material.

Installations shall be finished and left in a condition satisfactory to the Engineer.

The following specific provisions shall apply to the various types of construction:

A. Cast-in-Place Concrete

The foundation for manholes shall be thoroughly moistened immediately prior to placing concrete.

Steel reinforcement shall be placed in accordance with Section 57.

Concrete shall be protected and cured in accordance with Section 55. The minimum curing time shall be seventy-two (72) hours. The finished surface of the concrete shall present a neat and smooth appearance.

B. Pre-Cast Sectional Reinforced Concrete Units

The bottom-precast section shall be set in a full mortar bed and the joints between sections and around pipes shall be filled with mortar or an approved plastic cementing compound.

C. Adjusting Manholes

When the manhole ring and cover are to be lowered sufficiently to require reconstruction of the arch, or raised more than one (1) foot, or when the reconstruction of existing manhole is specified without change in grade, the manhole shall be reconstructed to the extent necessary to provide the adjustment specified.

When the ring and cover are to be lowered to an extent which does not require reconstruction of the arch, or when the ring and cover are to be raised one (1) foot or

less, the adjustment shall be made by removing the top as necessary and setting the ring at the proper elevation on a build-up of concrete.

D. **Manhole Steps**

Manhole steps shall not be installed.

Pipe culverts and storm drains (storm sewers) shall be tested in accordance with the provisions contained in Section 54 – Pipe Culverts.

63.4 METHOD OF MEASUREMENT

A. Pre-Cast Manholes

Manholes of pre-cast sectional reinforced units will be measured as a unit for each manhole constructed.

B. Cast-in-Place Concrete Manholes

Concrete and reinforcing steel for cast-in-place concrete manholes will be measured as provided in Sections 55 and 57, respectively.

Manhole rings and covers shall be included in construction of the manhole. No separate measurement will be made for manhole rings and covers.

C. Reconstructing or adjusting manholes will be measured as a unit for each manhole reconstructed or adjusted.

D. Flowable fill

Where no bid item for flowable fill is included in the Bid Proposal, such shall be incidental to the manhole.

63.5 BASIS OF PAYMENT

A. Pre-Cast Manholes

Manholes of pre-cast sectional reinforced concrete units will be paid for at the contract unit price bid per manhole, furnished and accepted, inclusive of materials, labor, equipment, excavation, and incidentals necessary.

B. Cast-in-Place Concrete Manholes

Concrete and reinforcing steel for cast-in-place concrete manholes will be paid for in accordance with Sections 55 and 57, respectively. The cost of excavation shall be absorbed in the cost of concrete.

The cost of manhole rings and covers shall be absorbed in the respective bid price for the type manhole to be constructed.

- C. Reconstructing or adjusting manholes will be paid for at the contract unit price bid per reconstruction or adjustment of manhole. Payment for this item will be full compensation for furnishing materials, labor, and equipment necessary.
- D. Flowable fill shall be paid in accordance with Section 200 – Controlled Low Strength Material.

END OF SECTION

SECTION 64

UNDER-DRAINS

64.1 DESCRIPTION

A. General

This work consists of subgrade drainage installations or repair of porous backfill and under-drain pipe or edge drain.

B. Related Work

Section 56 Concrete for Incidental Construction, Class M
Section 112 Select Granular Backfill
Section 202 Engineering Fabric

64.2 MATERIALS

A. Under-drain Pipe Trench Backfill Material

, Under-drain Pipe Trench Backfill Material shall conform to the requirements of Section 112.

B. Under-drain Pipe or Tubing

1. Corrugated Polyethylene Drainage Tubing

Corrugated polyethylene drainage tubing, couplings, and fittings shall conform to the requirements of AASHTO M 252, except Section 6.4 is modified as follows:

The length of the individual slots on the four-inch to eight (4 – 8) inches diameter tubing shall not exceed 12 percent of the tubing inside nominal circumference.

Corrugated polyethylene drainage tubing for use as edge drain or subgrade drain shall be a prefabricated system utilizing polyethylene drainage tubing . It shall be a flexible composite capable of following an irregular trench wall.

Corrugated polyethylene pipe, couplings, and fittings shall conform to the requirements of AASHTO M 294.

Drainage tubing used as sub-drains or edge drains shall have cleanouts installed at the upper ends. In lieu of a cleanout, where directed or approved by the Engineer, a penetration into a storm sewer culvert, inlet or pipe will be acceptable. The distance between cleanouts shall not exceed 500 feet.

2. Profiled Wall PVC Pipe

In lieu of corrugated polyethylene tubing, a profiled wall PVC pipe may be substituted. PVC and fittings shall meet the physical requirement specified for polyethylene pipe and shall meet the material requirements of ASTM D 3034.

Drainage pipe used as sub-drains or edge drains shall have cleanouts installed at the upper ends. A penetration into a storm sewer culvert, inlet or pipe will be accepted in lieu of a cleanout, where direct by the Engineer. The distance between cleanouts shall not exceed 500 feet.

- C. Drainage Fabric Material Drainage fabric material used to prevent soil migration into the under drain, shall conform to Section 202.
- D. Concrete, where required, shall conform to the requirements of Class M5, Section 56.
- E. Strip drain can be used as edge drain or subgrade drain with authorization of the Engineer. Strip drain used as edge drain or subgrade drain shall be a prefabricated system utilizing a $\frac{3}{4}$ in to 1 in thick by 12 in wide plastic double cusped core wrapped on both sides with drainage fabric and having channels capable of accepting drainage water from both sides. It shall be a flexible composite capable of following an irregular trench wall.

64.3 CONSTRUCTION REQUIREMENTS

The trench to receive the under-drain shall be excavated to the lines shown on the plans or as staked by the Engineer. The trench bottom shall be shaped and tamped as required by the Engineer. Disposal of surplus excavation shall be made by the Contractor and shall be incidental to the under-drain construction.

Prior to placement of Under-drain Trench Backfill Material a layer of drainage fabric material shall be placed in the trench. The material shall be of sufficient width to totally wrap the bottom, sides and top of the Under-drain Pipe Trench Backfill Material and pipe or tubing. There shall be a minimum 12 inch overlap of drainage fabric material over the top of the Under-drain Pipe Trench Backfill Material. Longitudinal sections shall have a minimum 12 inch overlap end to end.

Prior to placement of perforated or corrugated under-drain pipe or tubing, a layer of Under-drain Pipe Trench Backfill Material shall be placed to the depth shown on the plans and shaped to receive the pipe or tubing.

Perforated under-drain pipe or tubing shall be laid with the symmetrically placed holes on the lower side. In outlet sections, the pipe or tubing shall be either non-perforated or the symmetrically placed holes shall be on the upper side. The sections shall be well bedded at all points throughout their entire length and securely bolted or banded together.

Under-drain Pipe Trench Backfill Material shall be placed without compaction, in one (1) foot layers. It shall be uniformly spread without segregation or contamination. Tarpaulins or other approved devices shall be used as guides to transport the backfill material from the hauling vehicle to the trench to prevent pulling dirt in with the backfill.

Satisfactory free and unobstructed outlets shall be provided for all drains. Where possible, all outlets shall have a twelve (12) inch free fall and shall be properly marked. All outlets to daylight shall be protected with a four-inch by four inch, six-foot guide post painted with two (2) coats of white paint. Outlets to underground storm sewer shall be sealed to the storm sewer with a concrete grout collar.

Drain installations and waste disposal shall be furnished and left in a neat appearing condition satisfactory to the Engineer.

64.4 METHOD OF MEASUREMENT

A. Under-drain Pipe Trench Backfill Material

Where a separate bid item for Under-drain Pipe Trench Backfill Material is included in the bid proposal, Under-drain Pipe Trench Backfill Material will be measured to the nearest one-tenth (0.1) ton utilizing certified weight tickets delivered to the Engineer or his representative within 48 hours of material delivery and placement. Excess material used to fill unauthorized or oversized trench widths or other dimensions will not be measured for payment.

B. Installed pipe quantities shall be determined by measuring from centerline to centerline of all pipe and fittings. Measurements shall be to the nearest whole foot.

64.5 BASIS OF PAYMENT

A. Under-drain Pipe Trench Backfill Material

Where a separate bid item for Under-drain Pipe Trench Backfill Material is included in the bid proposal, Under-drain Pipe Trench Backfill Material will be paid for at the

contract unit price per ton. Where no such item is included, payment shall be incidental to the under-drain installation.

Payment for this item will include full compensation for furnishing the material, labor, equipment, and incidentals necessary.

- B. Under-drain pipe or tubing will be paid for at the contract unit price per linear foot for the various types and classes of pipe or tubing and shall include pipe or tubing, necessary fittings, bands, bolts, wyes, elbows, gratings, lids, covers, guide posts, screens, breathers, excavation, backfilling, drainage fabric material, and handling waste disposal.

END OF SECTION

SECTION 65

RIPRAP

65.1 DESCRIPTION

A. General

This work consists of furnishing and placing approved material for the protection of piers, abutments, walls, embankments, and other plan-designated locations.

B. Related Work

Section 109 Riprap and Slope Materials
Section 124 Fabric Formed Concrete Mat Material
Section 125 Gabions

65.2 MATERIALS

Riprap shall conform to the requirements of Section 109.

65.3 CONSTRUCTION REQUIREMENTS

Slopes to be protected by riprap shall be free of brush, trees, stumps, and other objectionable material and shall be dressed to a smooth surface. Soft or spongy material shall be removed to the depth shown on the plans or as directed by the Engineer and replaced with approved material. Filled areas shall be thoroughly compacted. A trench at least one (1) foot deep and one (1) foot wide shall be cut along the toe of the slope to receive the first or bearing course of large riprap stone.

Protection for structure foundations shall be provided as early as the foundation construction permits. The area to be protected shall be cleaned of waste materials.

Riprap shall be placed in a manner, which will produce a reasonably well graded mass of stone with the minimum practicable percentage of voids. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing of riprap in layers, or by dumping into chutes, or similar methods likely to cause segregation will not be permitted. The larger stones shall be well distributed, and the entire mass of stone shall conform to the gradation specified. Material going into riprap protection shall be placed and distributed so there will not be large accumulations of either the larger or the smaller size of stone.

To produce a compact riprap protection in which all sizes of material are placed in their proper proportions, hand placing or rearranging of individual stones by mechanical equipment may be required.

The riprap protection shall be placed in conjunction with the construction of the embankment. To prevent mixture of embankment and riprap, sufficient lag in construction of the riprap may be necessary. The Contractor shall maintain the riprap protection until accepted, and any material displaced by any cause shall be replaced at no additional cost to the Owner.

65.4 METHOD OF MEASUREMENT

Riprap will be measured to the nearest one-tenth (0.1) ton or one-tenth (0.1) cubic yard in accordance with the Bid Proposal.

65.5 BASIS OF PAYMENT

Riprap will be paid for at the contract price per ton or cubic yard of material furnished in accordance with the Bid Proposal.

Payment for this item will be full compensation for furnishing, loading, hauling, placing, spreading the stone, and for labor and equipment required for shaping, excavating and performing sub aqueous operations necessary.

END OF SECTION

SECTION 66

SLOPE PROTECTION

66.1 DESCRIPTION

A. General

This work consists of the excavation of toe trenches, slope preparation, the placement of drainage fabric or foundation filter material of sand or gravel, a spread of spalls, and/or a spread of dumped riprap stone.

B. Related Work

Section 65 Riprap
Section 105 Fine Aggregate for use in Portland Cement Concrete
Section 109 Riprap and Slope Materials
Section 124 Fabric Formed Concrete Mat Material
Section 125 Gabions
Section 146 Erosion Treatment Material
Section 202 Engineering Fabric

66.2 MATERIALS

- A. Riprap materials for slope protection shall conform to the requirements of Section 109.
- B. Filter material shall be a fine gravel or sand as specified in Section 105 or as directed by the Engineer.
- C. Spalls shall consist of broken or crushed Portland Cement Concrete conforming to the general gradation specifications of Section 109, Riprap and Slope Materials.
- D. Filter Fabric - Drainage Fabric shall conform to the requirements of Section 202.

66.3 CONSTRUCTION REQUIREMENTS

A. Slope Preparation

The leading or upstream edge of the area to receive slope protection shall be over excavated to the depth and width indicated on the plans to form a thickened edge and toe trench within which to embed the filter fabric or filter material.

Damage occurring in the toe trenches or on the slopes prior to or during the placement of the filter fabric or material, spalls and dumped riprap shall be satisfactorily repaired at the Contractor's expense. Soft or otherwise unsatisfactory areas shall be remedied in advance of placement of any filter fabric or material. Repair work shall be performed by the Contractor at his expense. The excavated material obtained from shaping the slopes and preparing toe trenches shall be suitably disposed of by the Contractor.

B. Placement of the Filter Material

The filter material shall be uniformly spread in the toe trench and on the fill slopes in one (1) layer without segregation. Compaction is not required. The spread of filter material shall present a uniform surface free of mounds, ridges and windrows.

C. Placement of Spalls

Spalls shall be dumped and spread upon the filter material to obtain the best possible graded mass and uniform thickness. Hand and rake methods may be used.

D. Placement of Dumped Riprap

The placement of riprap shall be in accordance with Section 65.

E. Placement of Drainage Fabric

Drainage fabric shall be placed on a prepared surface under the area to receive riprap or gabions, where indicated on the plans. The fabric shall be laid smooth with the Manufacturer's recommended overlap width in strips laid perpendicular to the direction of flow. The overlapping layer shall be laid to the upstream side.

6.4 METHOD OF MEASUREMENT

- A. The filter material will be measured to the nearest one-tenth (0.1) ton.
- B. Spalls will be measured to the nearest one-tenth (0.1) ton or one-tenth (0.1) cubic yard.
- C. The dumped riprap stone will be measured to the nearest one-tenth (0.1) ton or one-tenth (0.1) cubic yard.
- D. Drainage fabric will be measured to the nearest one-tenth (0.1) square yard, in place with no addition for overlap.

66.5 BASIS OF PAYMENT

- A. The filter material will be paid for at the contract unit price per ton. Payment for this item will be full compensation for furnishing the filter material, for excavation, the disposal of waste and for labor, equipment and tools required.
- B. The spalls material will be paid for at the contract price per ton or cubic yard. Payment for this item will be full compensation for furnishing the material, labor, equipment, and tools required to strip the pits, screen, crush, load, haul, place, and spread the spalls.
- C. The dumped riprap stone material will be paid for at the contract unit price per ton or cubic yard. Payment for this item will be full compensation for furnishing the material, excavation, the disposal of waste, labor, equipment, and tools required.
- D. The drainage fabric will be paid for at the contract unit price per square yard. Payment for this item will be full compensation for furnishing the material, excavation, the disposal of waste, labor, equipment, and tools required.

END OF SECTION

SECTION 67

FABRIC FORMED CONCRETE MAT

67.1 DESCRIPTION

A. General

The work consists of placing fabric envelope forms in a mat configuration on a prepared surface and filling the placed forms with a pump-able aggregate/cement water slurry mixture.

B. Related Work

Section 65	Riprap
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water For Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 124	Fabric Formed Concrete Mat Material
Section 200	Controlled Low Strength Material

67.2 MATERIALS

- A. Fabric forms for concrete mat shall conform to the requirements of Section 124.
- B. Portland Cement Slurry shall consist of a mixture of Portland cement, aggregate, and water so proportioned and mixed as to provide pump-able slurry in which solids remain in suspension. The mix shall be designed to obtain a minimum compressive strength of 2000 (2000) psi at twenty-eight (28) days when made and tested in accordance with AASHTO T 22 and T 23 and shall conform to the following requirements:
1. Portland Cement shall conform to Section 100.
 2. Water shall conform to Section 104.
 3. Aggregates shall conform to the requirements of Sections 105 and 107, except the gradation. The aggregate shall be reasonably well graded from the maximum size, which can be conveniently handled by approved pumping equipment.

67.3 CONSTRUCTION EQUIPMENT

The Portland Cement Slurry sampled at the outlet of the injection hose shall contain six and five-tenths (6.5) plus or minus one and five-tenths (1.5) percent, entrained air.

The addition of slurry fluidifier or other admixtures will require approval of the Engineer.

Areas to receive erosion protection shall be prepared in conformance with Section 65. Fabric formed concrete mat construction shall conform to the following requirements:

- A. The Contractor shall submit a description of materials to be used in the proposed method of operations and furnish records and data to demonstrate that the finished mat will meet the quality and properties required.
- B. The fabric envelope forms shall be positioned over the surface as shown on the plans or as directed by the Engineer. Where required, adjacent fabric panels shall be joined by field sewing the two (2) layers separately, edge to edge, to provide a monolithic fabric form. Un-sewn lapped joints or simple butted joints shall not be permitted.
- C. Fabric formed concrete mat shall not be constructed when the ground is frozen. The concrete mat shall be maintained at a temperature above thirty-two (32) degrees F. until it has attained a compressive strength of one thousand five hundred (1500) psi when tested in accordance with SD 409.
- D. Material for slurry shall be measured into the mix by volume or weight. The quantity of water shall be adequate to produce a pump-able consistency. Mixing shall not be less than one (1) minute. The slurry shall be continuously agitated prior to injection. At temperatures below seventy (70°) degrees F., the slurry may be held in the mixer or agitator a maximum of two (2) hours and for a maximum of one and one-half (1 1/2) hours at higher temperatures. If there is an interruption in pumping, the slurry shall be re-circulated through the mixer drum or agitator.

Only approved mixing and pumping equipment shall be used in preparation and handling of the slurry. Before mixer, agitator, and pumping equipment are used, oil or other rust inhibitors shall be removed from surfaces, which will be in contact with the slurry.

Slurry shall be injected into the forms in the sequence and through insert points spaced as provided. Slurry may be injected through injection hoses placed within the fabric envelope. The distance between the point of discharge from the hose to the end of panel or the edge of the fully injected portion of the panel shall not exceed the plans-provided maximum distance between injection points.

67.4 METHOD OF MEASUREMENT

Fabric Formed Concrete Mat will be measured and calculated to the nearest whole square foot of surface area. The surface area of mat buried along the perimeter of the protection areas will be included in the measurement quantity.

Fabric mat test specimens will not require field measurement.

67.5 BASIS OF PAYMENT

Fabric Formed Concrete Mat will be paid for at the contract unit price per square foot. Payment will be full compensation for materials, labor, equipment, and incidentals required for site preparation work, protection to maintain the mat above thirty-two (32°) degrees F., and furnish the fabric formed concrete mat.

Fabric mat test specimens will be paid for at the contract lump sum price. Payment will be full compensation for materials, labor, equipment, and incidentals required to cast, cure, and finish specimens for testing.

END OF SECTION

SECTION 68

BANK AND CHANNEL PROTECTION ROCK FILLED WIRE BASKETS

68.1 DESCRIPTION

A. General

This work consists of the furnishing and construction of rock-filled wire baskets.

B. Related Work

Section 65	Riprap
Section 66	Slope Protection
Section 69	Bank Protection Gabions
Section 109	Riprap and Slope Materials

68.2 MATERIALS

A. Stone

The stone shall be durable field or quarry stone, free of seams, cracks or other defects. Slabbed or elongated stone pieces will not be acceptable. Stones of questionable quality will be sampled and tested for durability in accordance with AASHTO T 96 and must have a L.A. Abrasion wear of not more than forty (40) percent to be acceptable.

B. Baskets

Wire shall meet the requirements of ASTM A 116, Class I. Cross wires shall be fourteen (14) gage wire. Horizontal cables shall be of two (2) strand construction consisting of twelve and one-half (12 1/2) gage wires. Other ties shall be nine (9) gage wire or other satisfactory material.

68.3 CONSTRUCTION REQUIREMENTS

The wire baskets shall be constructed and placed in accordance with the plans.

68.4 METHOD OF MEASUREMENT

Bank and Channel Protection Baskets will be measured by count of wire baskets furnished and accepted, inclusive of rock.

68.5 BASIS OF PAYMENT

Bank and Channel Protection Baskets will be paid for at the contract unit price per each. Payment for this item will be full compensation for materials, equipment, labor and incidentals necessary to construct the bank and channel protection.

When bank protection with rock and wire baskets is specified, the Contractor may substitute bank protection gabions meeting the requirements of Section 69 and be of the same thickness specified for rock and wire baskets. If substitution is made:

- A. Areas designated for bank protection will be adjusted slightly to accommodate dimensional inconsistencies between gabions and rock and wire baskets.
- B. Gabions will be measured and paid for on a volume equivalent basis of one and thirty hundredths (1.30) cubic yards/each (required volume of 4 ft 10 in x 4 ft 10 in x 1 ft 6 in rock and wire basket).

END OF SECTION

SECTION 69

BANK PROTECTION GABIONS

69.1 DESCRIPTION

A. General

This work consists of furnishing and installing open mesh wire baskets filled with rock.

B. Related Work

Section 65	Riprap
Section 66	Slope Protection
Section 68	Bank and Channel Protection Rock Filled Wire Baskets
Section 109	Riprap and Slope Materials
Section 125	Gabions

69.2 MATERIALS

A. Gabions shall conform to the requirements of Section 125.

B. Fill

The baskets shall be filled with approved stone ranging in size from a minimum of four (4) inches to a maximum of thirteen (13) inches, both measured in the greatest dimension. The stone shall meet the requirements specified in Section 68.

69.3 CONSTRUCTION REQUIREMENTS

Gabions shall be placed at the locations and as shown on the plans. Each gabion unit shall be assembled by binding together all vertical edges with twisted wire ties on approximately six (6) inch spacing or by a continuous piece of connecting wire stitched around the vertical edges with a coil about every four (4) inches. Hog rings will not be acceptable wire ties. Wire ties or connecting wire shall be used to join the units together in the same manner as described for assembling. Internal tie wires shall be uniformly spaced and securely fastened in each outside cell of the structure or where ordered by the Engineer. When gabions are being placed as slope protection, the cross-connecting wires may be deleted by the Engineer.

A standard fence stretcher, chain fall, or iron rod may be used to stretch the wire baskets and hold alignment.

The gabions shall be filled with stone carefully placed to assure alignment and avoid bulges with a minimum of voids. After the gabion has been filled, the lid shall be bent over until it meets the sides and edges. The lid shall then be secured to the sides, ends, and diaphragms, with the wire ties or connecting wire in the manner described for assembling.

69.4 METHOD OF MEASUREMENT

Bank Protection Gabions will be measured to the nearest even cubic yard. Computations will be based on the plan shown dimensions of the baskets.

69.5 BASIS OF PAYMENT

Bank Protection Gabions will be paid for at the contract unit price per cubic yard. Payment will be full compensation for materials, labor, equipment, and incidentals necessary.

END OFSECTION

SECTION 70

SEEDING

70.1 DESCRIPTION

A. General

This work consists of preparing a seedbed and furnishing and planting seed on disturbed areas within limits of the work.

B. Related Work

Section 71 Fertilizing
Section 72 Mulching
Section 76 Compost Application

70.2 MATERIALS

A. General

The seed furnished shall be the best quality seed available for the kind and variety specified. The seed shall comply with the requirements of the South Dakota Seed Law and shall be "Blue Tag" certified governed by Federal Regulations.

B. Origin Limitations

Seed furnished shall have been grown in South Dakota or an area comparable to South Dakota's growing conditions.

C. Seed Testing

Seed shall be tested within eighteen (18) months prior to the planting date. Testing shall be performed by a commercial seed testing lab or a registered member of the Society of Commercial Seed Analysts (Registered Seed Technologist). The Contractor shall furnish the Engineer with a certified test report prior to the start of seeding operations. Seed not planted within the eighteen (18) month period shall be retested for dormant seed, hard seed, and germination. A new certified test report shall be furnished. Testing shall be the responsibility of the Contractor.

D. Labeling

Before seeding begins, the Engineer shall verify that each bag of seed delivered to the project bears a tag, which shows the following information:

- Name and address of supplier.
- Project number for which the seed is to be used.
- Suppliers lot number for each kind of seed in the mixture.
- Origin (where grown) for each kind of seed.
- Purity, germination, and other information required by South Dakota Seed Law for each kind of seed.
- Pounds of bulk seed of each kind of seed in each bag.
- Total pounds of bulk seed mixture in each bag.
- Pounds of pure live seed (PLS) of each kind of seed in each bag.
- Total pounds of pure live seed (PLS) mixture in each bag.
- Dormant seed and hard seed.

When bulk seed is referred to, it is defined as total seed, including pure live seed (PLS), inert matter, crop seed, and weed seed.

E. Seed Mixes

Seed mixes for small applications, under two acres, may be the following:

a. Irrigated Lawn mix

80% of at least 3 varieties of Kentucky Bluegrass
 20% Perennial Ryegrass
 Rate of application – 175# per acre

b. Non-irrigated lawn mix

20% Blue Fescue
 20% Chewings Fescue
 20% Creeping Red Fescue
 20% Hard Fescue
 10% Perennial Ryegrass
 10% NuBlue Kentucky Bluegrass
 Rate of application – 200# per acre

c. Road Ditch mix

40% Crested Wheatgrass
 30% Perennial Ryegrass
 20% Hard Fescue
 10% Annual Ryegrass
 Rate of application – 100# per acre

Seed mixes for seeding areas over two acres shall be designed to meet site-specific requirements, such as soil type, orientation, slope, irrigation/no-irrigation, soil nutrients, and other.

The Contractor shall submit a seed mix listing the specific varieties of seed in the mix intended for use. The submittal shall be sent to the City of Rapid City Engineering Division, 300 Sixth Street Rapid City, S.D. 57701 for approval. A new submittal will be required annually. One submittal at the beginning of the year or one submittal for each project will be acceptable. If the mix changes from the original yearly submittal a new submittal will be required.

70.3 CONSTRUCTION REQUIREMENTS

A. General Requirements

Within seasonal limitations, seeding shall be done as soon as finish grading and topsoiling have been completed.

The topsoil to be used in the areas to be seeded or hydroseeded shall have a minimum depth of 6 inches.

Seeding or related work shall not be done when the condition of the soil is such that a satisfactory seedbed or uniform seed placement cannot be obtained. Seed shall not be sown when the wind is strong enough to interfere with uniform seed application. Seed shall not be sown on areas under water.

Slopes shall be worked longitudinally, on contour, during the preparation of areas, drilling, and after seeding.

Fertilizing shall be provided as indicated in Section 71. Mulching shall be provided as indicated in Section 72.

The Engineer may approve necessary adjustment in the requirements outlined to obtain the most satisfactory results under varying conditions.

The Contractor shall calibrate the drill or hydro seeder on each project. Calibration runs may be performed on areas to be seeded.

B. Seasonal Limitations

Seeding shall not be done between June 15 and August 31 without written authorization from the Engineer.

Seeding may be done when the ground is not frozen and condition of the soil permits preparation of a satisfactory seedbed. Seeding shall not be done without authorization from the Engineer.

C. Equipment and Methods

1. Seedbed Preparation

Initial preparation of newly graded areas for seeding shall be worked to a minimum depth of 6 inches. Every effort shall be made to obtain this depth on the first pass with tillage equipment. The implement used shall be a tool carrier with rigid shanks and sweeps or chisels or a heavy duty disk as appropriate to the conditions. The implement shall have positive means of controlling depth of penetration.

Lumps or clods exposed by the initial pass of tillage equipment over three (3) inches in diameter shall be broken up. The number of additional passes required breaking up lumps or clods shall be kept to a minimum. Working the soil to a fine, pulverized condition shall be avoided.

After seedbed preparation has been completed, the Contractor shall pick up and dispose of all loose stones or boulders having a vertical projection of two (2) inches (or more) above the soil surface. Logs, stumps, brush, weeds, cables, or other foreign material, which might interfere with the proper operation of drills, mowers, or other implements, shall be disposed of by the Contractor.

2. Mulching

Top dress newly seeded areas with mulch per section 72.

3. Reseeding of Previously Seeded Areas

Existing weeds and cover crop shall be preserved for its mulch value. The seed shall be drilled directly into existing cover if possible, or mowing and disking shall be provided to permit penetration of drill openers and placement of seed to the specified depth.

4. Drilling

The specified seed mixture shall be drilled in uniformly, using a press drill equipped with individually mounted, adjustable, spring-loaded, double-disk furrow openers, fitted with depth control bands or drums.

The depth control bands or drums shall provide a loose planting depth of one to one and one-half (1 - 1 ½) inches (distance from band to edge of opener disk) before compaction by the press wheel and a final planting depth of three-fourths to one (¾ - 1) inch behind the press wheel.

The press drill shall be mounted on rear press wheels, which carry a major portion of the weight of the drill and having no weight carrying wheels at the ends of the seed box. The press wheels shall be mounted independently of the furrow

openers. A press wheel shall follow directly behind each opener to compact the soil over the drill row.

The seed box shall be equipped with positive feed mechanisms, which will accurately meter the seed to be planted, and agitators which will prevent bridging in the seed box and keep seeds uniformly mixed during drilling. The drill shall conform to the following:

Drill Width Maximums:

Single Units.....	10 feet
Flex coupled side-by-side units	16 feet
(max. two 8-foot members)	

Each drill shall be equipped with a meter, which will measure the area covered by the drill.

Each drill shall be equipped with fabricated baffles or partitions mounted a maximum of two (2) feet on centers and flush with the top of the seed box and extending downward to within four (4) inches of the bottom of the seed box.

On areas where a press drill cannot be operated satisfactorily, hydraulic, cyclone, knapsack hand-operated, or other broadcast type seeders may be used, when approved by the Engineer.

5. Hydro seeding

Drilling is the preferred method of seeding. The Contractor shall obtain written permission from the Engineer to hydro seed.

The specified seed mixture shall be hydro seeded uniformly, using a hydro seeder.

The hydro seeder shall be equipped with a gear-driven pump and a paddle agitator. Agitation by re-circulation from the pump will not be allowed. Agitation shall be sufficient to produce homogeneous slurry of seed and fertilizer in the designated proportions.

Fertilizer of the specified formulation shall be included at the specified rate.

Specified seed mixtures shall be included at the specified rate. No seed shall be added to the slurry until immediately prior to beginning the seeding operation.

Legume seed shall be pellet inoculated with the appropriate bacteria. Inoculation rates shall be four times that required for dry seeding.

The time allowed between placement of seed in the hydro seeder and emptying of the hydro seeder tank shall not exceed thirty (30) minutes.

Wood cellulose fiber mulch shall be degradable, wood cellulose fiber or one hundred percent (100%) recycled long-fiber pulp, free from weeds or other foreign matter toxic to seed germination and suitable for hydro mulching.

D. Care during Construction and Final Inspection

The Contractor is responsible for smoothing dirt ridges, which result from his operations or from traffic. Such ridges shall be smoothed so they will not interfere with future mowing.

Following completion of seeding operations, foot, vehicular, or equipment traffic over the seeded area shall be kept to a minimum.

Areas damaged from such traffic shall be reworked and reseeded as determined by the Engineer.

The Contractor shall, prior to acceptance of the project, reseed any area on which the original seed has been lost or displaced.

B. Watering

After seed, fertilizer and mulch have been placed, it shall be watered to provide a moist condition through the mulch as well as into the underlying soil bed.

For a period of three weeks after seeding and initial watering, the Contractor shall apply adequate water to insure proper germination of the seed and growth of the grass. The Engineer may waive watering requirements if adequate natural moisture has been present. At the end of the three (3) week watering period, the Engineer will make an inspection to determine if the grass is alive and growing. If seed has not satisfactorily rooted into the soil and is not alive and growing, the Engineer will determine if new seed and/or additional watering, at the Contractors expense, are required. Replaced seed shall be watered as required for the original.

After the Engineers acceptance of the newly seeded areas, the Contractor shall notify all affected property owners, with notification of watering requirements provided by the Owner, that they will be responsible for watering the newly seeded areas. The Contractor shall provide written verification that affected property owners have both been notified and have accepted the condition of the newly seeded areas. The growing season is defined as May through September.

70.4 METHOD OF MEASUREMENT

Seeding will be measured to the nearest square yard. Measurement for fertilizer and mulch will be the same as for the seeding. Tickets indicating the appropriate application rate has been met shall be furnished to the Engineer to verify this area.

70.5 BASIS OF PAYMENT

Seeding will be paid for at the contract unit price per square yard. This price will be full compensation for the preparation of the seed and for labor, tools, equipment, and incidentals necessary.

Payment for seeding, fertilizing, and mulch will all be included under the same bid item. Water for seeding shall be considered incidental and shall be included in the unit price bid for seeding.

END OF SECTION

SECTION 71

FERTILIZING

71.1 DESCRIPTION

A. General

This material consists of furnishing and applying fertilizer materials on areas to be seeded or sodded.

B. Related Work

Section 70 Seeding
Section 72 Mulching
Section 76 Compost Application

71.2 MATERIALS

- A. Fertilizer shall be a dry, standard commercial product conforming to the South Dakota Fertilizer Law and subsequent amendments or revisions. Each brand and grade of fertilizer must be registered with the State Department of Agriculture. Each bag or other container shall clearly show the net weight of the contents, the name and address of the manufacturer, the brand and grade, and the guaranteed analysis of the contents, and showing the minimum percentages of total nitrogen available, phosphoric acid, and water soluble potash, in that order.
- B. Fertilizer shall be in a condition, which will permit proper distribution.
- C. Testing of fertilizer will not be required. Before any fertilizer is approved for use, the Contractor shall submit to the Engineer a certified statement from the manufacturer stating that the fertilizer is registered for sale in South Dakota and complies with the South Dakota Fertilizer Law. The certified statement shall include the Contractor's name, the project number, and all information that appears on the containers, as listed in "A" above.
- D. Fertilizer for small projects, under two acres of seeding area, shall be 18-46-0 which shall be applied at a rate of 200# per acre, unless specified otherwise by the Engineer.

Fertilizer type and quantity for projects with seeding areas larger than two acres shall be based upon testing of topsoil for horticultural properties. Test results and fertilizer type shall be submitted to the Engineer for approval.

71.3 CONSTRUCTION REQUIREMENTS

- A. Fertilizer shall be applied not more than forty-eight (48) hours prior to seeding or sodding, unless otherwise approved by the Engineer. Fertilizer shall be applied by one of the following methods:
1. With a fertilizer attachment on the drill, which will place the fertilizer in a band on or near the drill row behind the openers during the drilling operations (preferred method)?
 2. By drilling in with an approved drill prior to seeding.
 3. By spreading the fertilizer uniformly over the areas to be seeded prior to or during seedbed preparation (before final pass). This method will not be acceptable when seedbed preparation is not required.
 4. Where the seed is sown by a hydraulic seeder, the required amount of fertilizer may be placed in the tank, mixed together with the water and the seed, and applied in the seeding operation.
 5. Where required on areas to be sodded, thoroughly mix fertilizer into the top one (1) to two (2) inches of soil prior to laying sod.
 6. On slopes steeper than 3:1, where fertilizer cannot be incorporated into the soil effectively by mechanized equipment, fertilizer may be applied by any approved method and raked in to a depth of approximately one (1) inch.
- B. Clods and stones having a vertical projection of two (2) inches or more above the soil surface and other foreign materials brought to the surface shall be removed.
- C. The Contractor shall, prior to acceptance of the project, re-fertilize any area on which the original fertilizer has been lost or displaced, as determined by the Engineer.

71.4 METHOD OF MEASUREMENT

Fertilizing will be measured to the nearest square yard.

71.5 BASIS OF PAYMENT

Fertilizing will be paid for at the contract unit price per square yard, which will be full compensation for furnishing, hauling, placing, incorporating fertilizer into the work, labor, equipment, materials, tools, and incidentals necessary.

Payment for fertilizing, seeding, and mulching will all be included under the same bid item.

END OF SECTION

SECTION 72

MULCHING

72.1 DESCRIPTION

A. General

This work consists of placing a mulch cover on designated areas following seeding operations.

B. Related Work

Section 70 Seeding
Section 71 Fertilizing

72.2 MATERIALS

A. Grass Hay or Straw Mulch

Grass hay or straw mulching shall be substantially free of noxious weed seeds and objectionable foreign matter. The mulch shall have been baled dry, in bales of approximately equal weight and shall be relatively dry when applied. The Engineer will reject materials having characteristics, making them unsuitable for the purpose intended.

Bromegrass is not an acceptable mulch.

B. Fiber Mulch

Fiber Mulching shall contain no germination or growth inhibiting factors and shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like ground cover, which will readily absorb water and allow infiltration to the underlying soil without restricting emergence of seedlings. Weight specification from suppliers, and for all applications, shall refer only to air dry weight of the fiber, considered to be 10 percent moisture.

The fiber mulch material shall be supplied in packages marked by the manufacturer to show the air dry weight content. Suppliers shall certify that laboratory and field testing of their product has been accomplished, and that it meets all of the foregoing requirements.

C. Compost and Wood Chip Mulch

Compost shall be $\frac{3}{4}$ in. minus and $\frac{3}{8}$ in. minus screened material. Wood Chip Mulch shall be material passing the $\frac{3}{4}$ in. screen.

No chemical additives shall be added during the composting process. The process shall be completely natural utilizing the organic feedstock, water and air. The material shall be composted to a ratio of 30 parts carbon to 1 part nitrogen before screening the material. The compost shall be registered through the South Dakota Department of Agriculture as a soil amendment.

D. Hydroseeding Tackifier Amendment

Hydro seeding tackifier amendment shall be a safe, non-toxic polymer that can be used with any paper or fiber mulch products. The anionic high molecular weight polymer binds the hydroseeding media to the soil particles. The tackifier shall be hydrophobic and allow water into the mulch matrix. The tackifier shall be a synthetic material that is free of weed seed and any organic containments. It shall be compatible with biostimulants, fertilizers and surfactants. It shall not clump in the tank and clog the spray nozzle. The tackifier lubricates the slurry mix and tightens the slurry stream and will increase the shooting distance. The tackifier will break down from UV light in 5-6 weeks.

The tackifier can be used as a temporary dust abatement in non-traffic areas. The tackifier can be applied as a temporary soil stabilizer to protect against erosion. The tackifier can be applied through hydraulic equipment for clarifying sediment/holding ponds.

72.3 CONSTRUCTION REQUIREMENTS

A. Grass Hay or Straw Mulch

1. Placing Mulch

The rate of application shall be 4000 lbs. per acre unless otherwise specified by the Engineer. The mulch shall be placed within forty-eight (48) hours after the seeding has been completed. Mulching operations shall not be performed during periods of high winds, which preclude the proper placing of the mulch. The placing of mulch shall begin on the windward side of the areas to be covered.

The mulch shall be blown from a machine designed for that purpose and uniformly distributed over the seeded areas. The machine for placing the mulch shall be of an approved type, which will blow or eject, by constant air stream, a controlled amount of mulch. The machine shall cause a minimum of cutting or breakage in the length of the mulch.

Mulch containing excessive moisture, which prevents uniform feeding through the machine, shall not be used. Bales shall be broken up and loosened as they are fed into the blower to avoid placing of matted or unbroken lumps.

Mulch shall be placed uniformly over the seeded areas at the plan specified rates. The rates of application may be varied with the approval of the Engineer. Approximately ten percent (10%) of the soil surface shall be visible through the mulch blanket prior to mulch tiller (punching) operation.

Any existing cover left in place, as specified in Section 70.3C.2, shall be used as mulch, and the specified rate for mulching shall be reduced to leave ten percent (10%) of the soil surface visible through the mulch blanket and a loose thickness of cover of about one (1) inch prior to the punching operation.

Excessive cover, which will smother seedlings of small seeded grasses, shall be prohibited. The Engineer may order the placement of mulch on any area where protection is considered necessary to forestall erosion or encourage turf establishment.

B. Punching

Immediately following application, the mulch shall be punched into the soil by a mulch tiller consisting of a series of dull, flat disks with notched or cutout edges. The disks shall be approximately twenty (20) inches in diameter, one-fourth (1/4) inch thick, and shall be spaced approximately eight (8) inches apart and shall be fitted with scrapers.

Working width of the tiller shall not exceed six (6) feet per member, but may be operated in gangs of not over three (3) members. The tiller shall be operated on contour, except on slopes 3:1 or steeper, where the Engineer may order diagonal operation and, if necessary, dual drive wheelers or crawler tread on the tractor to minimize side slip and rutting damage to slopes.

Tiller members shall be ballasted to push mulch into the soil approximately three (3) inches with ends exposed above the soil surface. When light disking is required in existing cover so the seed can be drilled into a depth of one (1) to one and one-half (1 1/2) inches, the tiller members shall be ballasted to push mulch into the soil with the ends exposed above the soil surface. The Engineer shall determine on construction the depth to which the mulch is to be punched.

The mulch tiller shall follow as closely as possible behind the mulch blower. Mulch shall not be blown when the wind velocity causes appreciable displacement before it can be anchored by the mulch tiller. The Engineer may require more than one (1) pass of the mulch tiller or diagonal passes where necessary to assure adequate anchoring.

C. Fiber Mulch

Rate of application shall be 2000 lbs. per acre unless otherwise specified by the Engineer. Excessive thickness of mulch, which will smother grass seedlings, shall be avoided.

Mulch shall be placed on a given area as soon as possible, or within 48 hours after seeding.

D. Compost

Apply a ¼ inch layer of compost over the seeded area, then water to protect against hot, dry weather or drying winds.

E. Hydroseeding Tackifier Amendment

1. Hydro seeding

When using as a tackifier with paper or fiber mulch, add three pounds per acre. Slowly pour the tackifier into the water and thoroughly mix in the tank. Add mulch, seed, fertilizer and any other components in the tank and thoroughly mix.

2. Straw Tacking

Apply three pounds per acre with 750 pounds of wood or paper mulch.

3. Temporary Dust Control

Apply to non-traffic areas at a rate of three pounds per acre with 1000 gallons of water. On slopes of 4:1 to 2:1 apply at a rate of 6-12 pounds per acre.

4. Clarifying sediment/holding ponds

Slowly pour two-three pounds of tackifier into 1000 gallons of water while the tank is agitating. Thoroughly mix for 15 minutes and spray to one surface acre of water.

F. Care During Construction and Final Acceptance

Traffic, either foot, equipment, or vehicular, shall be kept to a minimum over the seeded and mulched areas.

The Contractor shall, prior to acceptance of the project, re-mulch any area on which the original mulch has been displaced as a result of excessive wind, water, or other causes.

72.4 METHOD OF MEASUREMENT

Mulching will be measured to the nearest square yard.

72.5 BASIS OF PAYMENT

Mulching will be paid for at the contract unit price per square yard, which will be full compensation for furnishing, hauling, placing, and punching, and for materials, equipment, labor, tools, and incidentals necessary. Hydroseeding Tackifier Amendment shall be included in the contract unit price bid per square yard for mulching when used as a mulch tackifier.

Payment for mulching, seeding, and fertilizing will all be included under the same bid item.

Compost and Wood Chip Mulch will be paid for at the contract unit price per ton, which will be full compensation for furnishing, hauling, and placing, and for materials, equipment, labor, tools, and incidentals necessary.

When Hydroseeding Tackifier Amendment is being used for temporary dust control or clarifying sediment/holding ponds the Hydroseeding Tackifier Amendment will be paid for at the contract unit price per acre which will be full compensation for furnishing, hauling, and placing, and for materials, equipment, labor, tools, and incidentals necessary.

END OF SECTION

SECTION 73

SODDING

73.1 DESCRIPTION

A. General

This work consists of preparing the ground surface and furnishing, transporting, and placing live sod and other materials.

B. Related Work

Section 17 Salvaging, Stockpiling, and Placing Topsoil
Section 71 Fertilizing
Section 76 Compost Application

73.2 MATERIALS

The sod shall consist of a dense, well-rooted growth of Kentucky Blue Grass or other approved grass native to the general locality of the project. The sod shall be free from noxious weeds and substantially free from other objectionable grasses, weeds, or foreign materials detrimental to the development and future maintenance of the sod.

At the time the sod is cut, the grass shall have a length of approximately two inches. If longer than three inches, the grass shall be cut to approximately two inches in length, and the sod shall have been raked free of debris. Sod shall be delivered to the jobsite in live, moist condition without undue crumbling or breaking.

If the sod is in a dry condition so that it cannot be cut, rolled, loaded, and hauled to the jobsite, without crumbling or breaking, the Contractor shall apply water to the sod in sufficient quantities to provide a well-moistened condition of the sod to the depth to which it is to be cut. This watering shall be at no additional cost to the City.

Water used on sod shall be from municipal, domestic, or other sources known to be suitable for irrigation.

Fertilizer shall be provided as indicated in Section 71.

73.3 CONSTRUCTION REQUIREMENTS

A. Cutting and Salvaging Sod

Sod shall be machine cut into rectangular sections. The sections shall be of uniform width of not less than 10 inches or more than 24 inches. The sections may vary in length, up to nine feet maximum. The sod shall be cut to a depth of three-fourths inch or more so the dense root system will be retained and exposed in the bottom side of sod, and the sod can be handled without undue tearing or breaking. Sod shall be rolled with the top growth inside. Sod strips, which indicate crumbling, tearing, breaking, or loss of soil during the operations of cutting, transporting, or handling will not be acceptable. Sod shall be laid in its final position within 36 hours after being cut. During the period between cutting and laying, the sod shall be protected from damage.

B. Preparing Surface for Sodding

The surfaces to be sodded shall be constructed to the required cross-section and contour and shall be smooth, uniform, and free from stones, roots, or other undesirable foreign material. These surfaces shall be undercut to sufficient depth below adjacent areas so the top of newly-laid sod will be flush with any adjacent seeded or turfed areas and one inch below top of sidewalks, curbs, or other structures. Some trenching-in of the areas to be sodded and some building up of the adjacent areas may be necessary. The adjacent areas shall smoothly blend with each other, without sharp breaks in the contours.

The prepared soil bed shall be inspected and approved prior to sodding. If the soil bed is dry and/or hot, the Engineer may require the Contractor to pre-water to a depth of one inch prior to sodding. The earth planting bed shall be allowed to dry sufficiently after watering to permit sod placement without tracking.

Immediately prior to placing the sod, the soil shall be loosened and brought to a fine granular texture, to a depth of not less than one inch. Clods, lumps, weeds or other unsatisfactory materials shall be removed.

Fertilizer shall be uniformly incorporated into the soil prior to sodding. The same fertilizer and ratio of application as specified for seeding shall be used.

C. Laying Sod

Sod shall be placed as soon as practicable following the winter season. When sod is available in the spring, the Engineer may issue written notice requiring the Contractor to begin placing sod within 10 working days of receipt of the notice. Failure to begin placement of the sod within the specified time shall result in issuance of a stop-work order. However, contract time will continue to be counted.

The sod on berm slopes shall be laid by hand in horizontal strips, beginning at the bottom of the slope and working upwards. In waterways, strips shall be laid parallel to the flow. Each section of sod shall be laid parallel to the flow. Each section of sod shall join the adjacent sections without overlapping but shall abut snugly against the section previously laid. End joints shall be staggered and open joints or gaps shall be filled with sod cut to the proper size and shape.

The top and bottom ends of sodded areas shall extend at least two inches into the ground or ditch bottom. Other edges of sodded areas shall be turned into the ground two inches and covered with a layer of topsoil which shall be compacted to conduct the surface water over the edge of the sod and blend the sodded areas into the adjacent finished grades.

D. Anchoring

On slopes steeper than 6:1, the sod shall be anchored with one inch wide by six inch long U-shaped staples made from No. 11 or heavier ungalvanized steel wire. A minimum of four staples per sod strip in every other row shall be used.

In waterways, two staples shall be placed in the upper end of each sod strip in the end facing flow.

Staples shall be driven flush with the top of the sod. Additional staples as required, to obtain adequate anchoring shall be placed as determined by the Engineer.

E. Watering

After sod has been laid, it shall be watered to provide a moist condition through the thickness of the sod and 6 inches into the underlying soil bed.

For a period of three weeks after sodding and initial watering, the Contractor shall apply adequate water to insure proper germination of the seed and growth of the grass. The Engineer may waive watering requirements if adequate natural moisture has been present. At the end of the three week watering period, the Engineer will make an inspection to determine if the sod is rooted into the underlying soil and is alive and growing. If sod has not satisfactorily rooted into the soil and is not alive and growing, the Engineer will determine if new sod and / or additional watering, at the Contractors expense, are required. Replaced sod shall be watered as required for the original.

After the Engineers acceptance of the newly sodded areas, the Contractor shall notify all affected property owners, with notification of watering requirements provided by the Owner, that they will be responsible for watering the newly sodded areas. The Contractor shall provide written verification that affected property owners have both been notified and accepted the condition of the newly sodded areas.

The growing season is defined as May through September.

F. Rolling

While not generally required, rolling may be specifically ordered for any areas where an especially smooth and level surface is desired.

G. Seasonal limitations on sodding shall be the same as for seeding.

73.4 METHOD OF MEASUREMENT

Sodding will be measured to the nearest whole square yard. Necessary resodding of areas damaged from causes beyond the control of the Contractor will be measured and added to the original quantity used.

73.5 BASIS OF PAYMENT

Sodding will be paid for at the contract unit price per square yard. Payment will be full compensation for cutting, preparing the earth planting bed, for furnishing, hauling, placing, anchoring, rolling, tamping, and maintaining the sod, and for labor, equipment, tools, and incidentals, which may be necessary.

Payment for fertilizing sod and sodding will be included under the same bid item. Water for sodding shall be considered incidental and shall be included in the unit price bid for sodding.

END OF SECTION

SECTION 74

PLANTING TREES, SHRUBS, AND VINES

74.1 DESCRIPTION

A. General

This work consists of furnishing and planting or transplanting trees, shrubs, vines, or other plants of the species, grade, and size specified. Included is the preparation of the ground, storage, staking, wrapping, furnishing and placing topsoil, peat moss, mulch, water, and other incidentals.

B. Related Work

Section 7	General Conditions
Section 17	Salvaging, Stockpiling and Placing Topsoil
Section 70	Seeding
Section 71	Fertilizing
Section 72	Mulching
Section 73	Sodding
Section 75	Transplanting Trees and Shrubs
Section 76	Compost Application

74.2 MATERIALS

A. Plant Materials (Nursery Stock)

1. Limitations on Source of Material

Plants furnished shall have been grown in western South Dakota or states or provinces located within the boundaries of Hardiness Zones 2, 3, or 4, as established by the United States Department of Agriculture.

2. Notification of Source of Supply and Verification of Origin

As soon as possible and before any planting, the Contractor shall furnish written notification of the location of the proposed source for each item of plant materials. The Engineer may require the Contractor to furnish written verification from the supplier and grower to establish the origin of plant materials, seed, or vegetative material. The source of supply and origin of plant materials will be subject to approval.

3. Names of Plants

Plant materials furnished shall be of the genus, species, and variety specified and shall follow standard names of plant materials as adopted by the American Joint Committee on Horticultural Nomenclature and as this standard nomenclature is referred to in the current edition of Standardized Plant Names. Substitutions will not be permitted without the written consent of the Engineer.

4. Form, Shape, and Condition of Plants

Trees furnished shall have been at least twice transplanted or root pruned, shall be well branched according to species or variety, and uniformly straight-trunked. Shrubs shall have been at least twice transplanted or root pruned and is heavily caned. Trees, shrubs, and vines shall be number one (1), heavy-grade, nursery-grown stock, strong, healthy, clean, well-grown, free from insects, disease, rodents, mechanical injuries, disfiguring knots, sunscald, frost cracks, broken bark, broken or dead branches, broken roots, stubs, or any other objectionable features and shall possess a healthy, normal root system of sufficient size to permit successful establishment and good growth and shall be typical of the species or variety specified. Evergreen plants delivered to the project with new growth in an advanced stage of candling out will be rejected.

5. Size of Plants

Plants shall be of uniform height and diameter. The figures shown on the plans indicate the minimum height of the plants called for. When such figures are used in connection with spread, they indicate the minimum and maximum spread of the plant to be furnished.

The height of each species or variety of plant shall be the vertical measurement of the plant from the ground upward as it stands in its natural position in the nursery without straightening branches or leaders. The measurements shall not include the fine or slender terminal leader, twig or branch growth, but shall stop where the main part of the plant ends. The spread of each species or variety shall be the horizontal measurement of the plant as it stands in its natural position in the nursery without straightening its branches. The measurements shall not include the fine or slender terminal shoots. Each plant shall be measured both in its smallest and greatest dimension and averaged. Caliper shall be taken six (6) inches above the ground level, up to and including four (4) inches caliper size, and 12 inches above ground level for larger sizes.

6. Nursery Stock

Plant materials shall be nursery grown unless otherwise specified, shall have been subjected to proper transplanting during growth in the nursery, shall bear evidence of proper top and root pruning, and shall be thrifty, well-grown, and hardy northern stock, grown under the same climatic conditions as exist at the location to be planted. Plants shall meet the standards as set forth in South Dakota Nursery Laws and in the edition of the American Standard for Nursery

Stock. In all cases where grades are indicated in these standards, No. 1 or top grade will be required.

7. 7. Labeling

Legible labels must be attached to all specimens, boxes, bundles, bales, or other containers indicating the genus, species, size, grade, or age of each species or variety and the quantity contained.

8. Inspection, Certificates, and Rejection of Plants

Before removal from the nursery, plant materials, must be inspected by authorized Federal or State authorities. Plants must be declared and certified free of diseases and insects, and necessary inspection certificates to this effect must accompany each shipment, invoice, or order of plants. Plants not approved by the Plant Industry Representative or Nursery Inspector or otherwise not meeting these specifications will be rejected. Rejected plants shall immediately be removed and disposed of by the Contractor and replaced with approved nursery stock of like variety, size, and age at no additional cost.

B. Incidental Materials

1. The topsoil shall conform to the requirements of Section 17.
2. Organic soil conditioners shall be granulated peat moss or other material as specified. The granulated peat moss shall be furnished in an air-dry condition and shall be free from woody substances and mineral matter such as sulfur or iron.
3. Mulching material shall be as specified.
4. Staking materials shall be six-foot (6 ft.) T type studded steel posts. Guy wire shall be a minimum of 12 gauge.
5. Wrapping material shall be a 2-ply asphalt cemented Kraft crepe paper in strips or burlap in strips and shall be secured to the trunk with a good-quality 6-ply cotton.
6. Tree ties shall be minimum one (1) inch wide heavy duty canvas with a steel grommet in each end to secure tie wire. Tie wire shall not be wrapped around tree, but shall be tied through the steel grommets in the canvas wrap. Lengths of garden hose shall not be used.
7. Tree trunk guards shall be minimum six (6) inch diameter by twelve (12) inch length flexible PVC drain tile pipe.

74.3 CONSTRUCTION REQUIREMENTS

A. General

The digging, transporting, storing, layout, planting, pruning, watering, mulching, wrapping, staking, maintenance, and replacement of plants shall be performed by a qualified nurseryman, landscape specialist or by experienced crews under the direct supervision of a qualified nurseryman or landscape specialist.

B. Digging and Transporting Nursery Stock

Plants shall be dug with care and skill immediately before shipping. Possible injury to the roots, particularly to the fibrous roots, shall be avoided. Balled and burlapped plants shall be dug to retain as many fibrous roots as possible and shall come from soil which will form a firm ball. The soil in the ball shall be the original undisturbed soil in which the plant has been grown. The plant shall be dug, wrapped, packed, and transported in such a manner that, upon delivery, the soil in the ball will not have been cracked, loosened, or caused to drop away from contact with the small and fine feeding roots.

As plants are dug and during transportation to the planting site, precautions shall be taken to prevent roots from drying out, balls of earth from being broken, and to otherwise assure the arrival of plants at their destination in good condition.

C. Temporary Storage

Plant materials which cannot be immediately planted upon delivery shall be heeled in by placing the plants in a trench in a shaded location and covering the roots firmly with moist soil or by storing in a cool, moist cellar or similar enclosure with roots packed in wet sphagnum moss and covered with tarpaulins. Other methods of storage must be, approved by the Engineer. Roots shall be kept thoroughly moist at all times, and stored plants shall be properly maintained by the Contractor.

Balled and burlapped plants shall be protected against drying of the ball by covering with wet sawdust, soil, or peat moss in a manner appropriate to the conditions.

Risks involved in storing and transporting plant materials shall be borne by the Contractor.

D. Staking and Layout of Planting

Planting holes shall not be dug until all plant locations have been staked. Plan-shown locations, spacings, and quantities may be adjusted by the Engineer to suit field conditions.

E. Planting - General Requirements

1. The Contractor shall notify the Engineer at least one (1) week in advance of the beginning of the planting operation.
2. During planting operations, suitable warning signs shall be provided in accordance with Section 7.

F. The Planting Operation

1. Digging of Planting Holes

- a. The Contractor shall provide necessary safeguards to prevent accidents during the time the plant holes are open.
- b. Planting holes shall have vertical sides and flat bottoms. The holes shall be of sufficient diameter to provide for not less than 12 inches of topsoil backfill around the root ball. The hole shall be no deeper than the root ball is tall. Set the rootball on firm soil so that the top of the rootball will sit slightly higher than the final grade.

2. Mixing Backfill Soil

Prior to planting, topsoil to be used for backfilling plant holes shall be thoroughly mixed with twenty-five percent (25%) peat moss by volume.

3. Care of Plants Prior to Planting

When plants are taken from storage to the planting site, roots of plants shall be immersed in water immediately upon opening the bundle and kept in water until planted. The Contractor shall have sufficient tanks and pails to keep roots of plants from opened bundles in water until planted.

In transferring plants from the site of temporary storage to the planting site, only plants that can be planted in that day shall be transferred. Material not planted the day it is taken from storage shall be rewrapped in the approved manner or the roots kept immersed in water at the storage site until planted.

Bare roots shall not lie exposed to the sun or air.

4. Method of Planting

a. Bare-rooted plants

Plants shall be set in the bottom of the planting holes on a compact cone of soil constructed by backfilling the planting hole with topsoil. Trees and shrubs shall be placed at the same depth as they grew in the nursery.

Roots shall be carefully spread over and around this cone of topsoil in their natural position.

Roots, which are broken or damaged, shall be cut back to firm tissue. After placing the plant in the hole and spreading the roots, topsoil shall be tamped in place carefully but firmly to insure that topsoil is around all of the roots and air pockets are not present. Care shall be taken to avoid bruising or breaking the roots when firming the soil around them.

b. Balled and burlapped plants

Plants shall not be handled by the plant stem. After the planting hole is dug as described in 74.3.F.1.b, the bottom portion of the wire basket shall be cut away prior to setting the plant in the hole. After setting plant in planting hole, the remaining portion of the wire basket shall be removed and the burlap cut six (6) inches below the top of the root ball. All twine and shipping tree wraps shall be removed from the trunk. Balled and burlapped plants shall have a minimum of 12 inches of top soil packed around the sides of the root ball.

c. Potted plants

Potted plant holes shall be dug as described in 74.3.F.1.b. All plants shall be removed from containers in a manner, which does not damage the root ball.

d. Holes shall be backfilled in not less than two (2) lifts, the first lift shall not exceed one half (1/2) total hole depth. Each lift shall be heel tamped.

5. Cultivation

Shrub beds are to be cultivated as a unit two (2) feet on each side of rows before planting and the plants placed separately.

6. Watering

All plants shall be thoroughly watered within four (4) hours of planting and every seven (7) days thereafter until a letter of acceptance for the project is received from the Engineer. Each plant shall receive the gallon equivalent on the size of the root ball planted, at each watering.

7. Mulching

Mulch shall be placed between and around the plants within forty-eight (48) hours after planting and shall be applied uniformly to cover the cultivated areas inside dikes to a depth of three (3) inches. Mulch shall be pulled back a minimum of 1 foot from trunks and canes.

8. Wrapping

Newly transplanted deciduous trees shall be wrapped with strips of 2-ply Kraft asphalt crepe paper or burlap, starting at the bottom and lapping one-half (1/2) strip to a point well into the crown of the tree and not less than four (4) feet above the ground. Wrapping shall be secured with 6-ply cotton twine, starting at the top and wrapping toward the bottom, or with as many separate ties as necessary to hold the wrapping securely but loosely enough to allow a normal season's growth.

9. Staking

Each newly-planted deciduous tree under three (3) inches in caliper or conifer tree under eight (8) feet in height shall be staked with three (3) standard "T" type studded posts. The posts shall be driven an adequate distance away from the trunk of the tree so they are not driven into the root ball of the newly planted tree. A tie wire, 12-gauge minimum, shall be used for each post. Canvas tree ties shall secure the tie wire to the tree as specified in 74.2.B.6. Three (3) ties per tree are required.

10. Guying

Deciduous trees over three (3) inches in diameter or conifers over eight (8) feet in height shall be guyed. Guy wires, minimum 12 gauge, shall be secured using canvas tree ties and six (6) foot "T" type studded posts. Three (3) guys per tree are required. Posts shall be driven a minimum of two (2) feet into the ground.

G. Cleanup

When planting has been completed, debris and waste materials shall be removed from the area, excess earth materials graded or otherwise removed, damaged turf reseeded, and the area left in a neat, orderly, and finished condition.

H. Establishment Period

An establishment period shall begin immediately after original planting is made and shall continue for one year. The plants shall be guaranteed during this period against defects, including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse, or damage by others, or unusual phenomena or incidents, which are beyond, landscape installer's control.

Contractor shall be responsible for watering all plants until a letter of acceptance for the project is received from the Engineer.

I. Replacement of Plants

The Contractor shall remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during establishment period. The Contractor shall

also plant missing trees, shrubs, and plants, make replacements during growing season following end of establishment period, and furnish and plant replacements which comply with requirements shown and specified. The Contractor shall also replace trees and shrubs, which are in doubtful condition at end of the establishment period, unless, in the opinion of the Engineer, it is advisable to extend the establishment period for a full growing season. The Engineer will make another inspection at the end of the extended establishment period to determine acceptance or rejection. Only one (1) replacement will be required at the end of the establishment period, except for losses or replacements due to failure to comply with specified requirements.

74.4 METHOD OF MEASUREMENT

Quantities of each species or variety of trees, shrubs, and vines will be determined from count of each.

74.5 BASIS OF PAYMENT

Upon satisfactory completion of planting, payment will be made at the contract unit price per tree, shrub, or vine. Payment will constitute full compensation for furnishing, transporting, handling, storing, planting, wrapping, pruning, watering, necessary excavation, disposal of surplus materials, furnishing and placing topsoil, peat moss, staking, mulching material, and labor, equipment, tools, and necessary incidentals.

END OF SECTION

SECTION 75

TRANSPLANTING TREES AND SHRUBS

75.1 DESCRIPTION

A. General

This work consists of furnishing and transplanting large trees or shrubs. This item shall include digging, transplanting, guying, mulching, and other incidentals necessary.

B. Related Work

Section 17 Salvaging, Stockpiling and Placing Topsoil
Section 70 Seeding
Section 71 Fertilizing
Section 72 Mulching
Section 73 Sodding
Section 74 Planting Trees, Shrubs, and Vines
Section 76 Compost Application

75.2 MATERIALS

A. Plant Materials

1. Plant material shall be the genus, species, and variety specified by the plans. Substitutions will not be permitted other than specified by the plans or by written consent of the Engineer.
2. Form and shape of plants shall be subject to the approval of the Engineer. Plants collected from shelterbelts, wild stands, or other sources shall be reasonably uniform in shape, with straight trunks, and well branched, free from injuries, disease, and insects and typical of the species or variety specified.
3. Plants shall be of the size specified in Section 74.

B. Equipment and Incidental Materials

1. Transplanting shall be done with a multiple cutting cup or spade-type digger designed for the purpose. Suitability of the machine and method of digging and transporting plant material shall be subject to the approval of the Engineer.
2. The topsoil used in planting shall conform to the requirements of Section 17.

3. Mulching materials shall conform to the requirements of Section 74.
4. Staking materials shall conform to the requirements of Section 74.

75.3 CONSTRUCTION REQUIREMENTS

A. General

The digging, transporting, planting, pruning, watering, mulching, guying, maintenance, and replacement of plants shall be performed by experienced crews under the direct supervision of a qualified nurseryman or landscape specialist.

B. Planting general requirements shall be as specified in Section 74.

C. Staking and layout of planting shall be as specified in Section 74.

D. Digging, Transporting, and Planting

Plants machinery moved shall be dug with care, avoiding mechanical injury to trunks and branches.

1. A planting hole shall be dug at the project site for each plant before the plant intended for that hole is removed from its original position. When a plant is dug from its original position, it shall be transported directly to the project site in the digging machine, with earth ball intact and carefully placed in its planting hole directly from the machine. Care shall be taken during digging, transporting, and resetting to assure earth ball is kept intact throughout the operation to avoid root breakage.
2. After plant is set straight in its hole and the spades removed, any voids between hole and earth ball shall be filled with good topsoil and tamped.
3. Watering shall be provided as specified in Section 74.

E. Plants shall be guyed as specified in Section 74.

F. Mulching shall be applied as specified in Section 74.

G. Trees shall not be pruned except to remove damaged or broken ends.

H. Cleanup shall be as specified in Section 74.

I. Establishment period shall be as specified in Section 74.

J. Replacement planting shall be as specified in Section 74.

75.4 METHOD OF MEASUREMENT

Quantities of each species or variety of trees and shrubs planted will be determined from actual count.

75.5 BASIS OF PAYMENT

Basis of payment will be as specified in Section 74.

END OF SECTION

SECTION 76**COMPOST APPLICATION****76.1 DESCRIPTION****A. General**

This work shall consist of incorporating compost within the root zone to improve soil quality and plant growth. This specification applies to all types of turf establishment methods (including seeding, sprigging, sodding, and hydroseeding) and plantings (including trees, shrubs, vines, ground covers, and herbaceous plants). Compost use as a soil amendment shall only be required as directed by the Designer.

B. Related Work

Section 70	Seeding
Section 71	Fertilizing
Section 73	Sodding
Section 74	Planting Trees, Shrubs, and Vines
Section 75	Transplanting Trees and Shrubs

76.2 MATERIALS

Compost shall be well decomposed, stable, weed free organic matter source. It shall be derived from agricultural, food, or industrial residuals; biosolids (treated sewage sludge); yard trimmings, or source-separated or mixed solid waste. The product shall contain no substances toxic to plants. For acid loving plants, provide only compost that has not received the addition of liming agents or ash by-products. Composts containing available nutrients, primarily nitrogen, are preferred, while the use of unstable or immature compost is not approved. Care should be given when using composts possessing a basic pH (>7) near acid loving plants.

76.3 PRODUCT PARAMETERS

Figure 1 Model Compost Specification for General Landscape Applications (soil amending)

Parameters	Reported as (units of measure)	General Range
pH	pH units	5.0-8.5
Soluble Salt Concentration (electrical conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, wet weight basis	30 - 60
Organic Matter Content	%, dry weight basis	30-65
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through ¾" screen or smaller
Stability Carbon Dioxide Evolution Rate	Mg CO ₂ -C per g OM per day	< 8
Maturity (Bioassay)		

Seed Emergence and Seeding Vigor	%,relative to positive control %, relative to positive control	Minimum 80% Minimum 80%
Physical Contaminants	%, dry weight basis	< 1
Chemical Contaminants	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR 503.13, Tables 1 and 3 levels
Biological Contaminants Select Pathogens Fecal Coliform Bacteria, or Salmonella	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR 503.32(a) levels

76.4 CONSTRUCTION REQUIREMENTS

A. Soil Analysis

Before any soil preparation procedures ensue, a soil analysis shall be completed by a reputable laboratory to determine any nutritional requirements, pH and organic matter adjustments necessary. Once determined, the soil shall be appropriately amended to a range suitable for the turf species to be established. A copy of the results of the soil analysis shall be provided to the Engineer.

B. Turf Establishment

Compost shall be uniformly applied over the entire area at an average depth of 1 to 2 inches and incorporated to a minimum depth of 6 inches (for a 20% to 30% inclusion rate) using a rotary tiller or other appropriate equipment. The Designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied before incorporation, as necessary. The use of stable, nutrient rich composts may reduce initial fertilizer requirements by the amount of available nutrients in the compost. Rake the soil surface smooth prior to seeding, sprigging, sodding, or hydroseeding. The soil surface shall be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance. Water thoroughly after seeding, sprigging, or sodding.

C. Planting Bed Establishment

Compost shall be uniformly applied over the entire area at an average depth of 1 to 2 inches. The Designer shall specify the compost inclusion rate depending upon soil conditions and quality, plant tolerances, and manufacturer's recommendations. Incorporate uniformly to a minimum depth of 6 inches using a rotary tiller or other appropriate equipment. Lower compost application rates may be necessary for salt sensitive crops or where composts with higher salt levels are used. Pre-plant fertilizer and pH adjusting agents (e.g., lime and sulfur) may be applied before incorporation, as necessary. The use of stable, nutrient rich composts may reduce

initial fertilizer requirements by the amount of available nutrients in the compost. Rake soil surface smooth prior to planting. The soil surface shall be reasonably free of large clods, roots, stones greater than 2 inches, and other material which will interfere with planting and subsequent site maintenance. Water thoroughly after planting.

76.5 METHOD OF MEASUREMENT

Compost will be measured by the ton.

76.6 BASIS OF PAYMENT

Compost application will be paid for at the contract unit price per ton, which will be full compensation for furnishing, hauling, and placing, and for materials, equipment, labor, tools, and incidentals necessary.

SECTION 90

TRAFFIC CONTROL

90.1 DESCRIPTION

A. General

This work consists of furnishing, installing and maintaining required traffic control devices.

B. Related Work

Section 91 Traffic Control Devices
Section 92 Traffic Signals and Roadway Lighting
Section 93 Pavement Marking and Permanent Signage

90.2 MATERIALS

High Intensity Reflective Sheeting Type III or higher will be required for use on all signs and other traffic control devices utilized for nighttime operations. Engineering Grade Medium-Intensity reflective sheeting will be allowed for daytime use only.

Metallic Barrels or Drums will not be allowed as traffic control devices.

Traffic control devices shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD).

90.3 CONSTRUCTION REQUIREMENTS

A. General

The Contractor shall furnish, install, and maintain required pavement marking material, barricades, lighting devices, flags, channeling devices, signals, signs and delineators; provide a sufficient number of watchmen and flaggers, and take the necessary precautions for protection of the workers, work area, and the safety of the traveling public.

Standard for flaggers and flagging practices shall be as set forth in Part VI of the MUTCD. The Contractor shall provide each flagger with a copy of the "Traffic Flagging Handbook" booklet. These booklets are available from the South Dakota Department of Transportation (SDDOT).

All existing traffic control devices shall remain the property of the City. All signs/posts shall be removed by the Contractor, unless otherwise directed on the plan sheets or by the Engineer. All signs/posts removed shall be delivered to the City of Rapid City, Traffic Operations yard at 709 Steele Avenue. A receipt is to be provided by the Contractor to the project inspector for all signs delivered to the Traffic Operations yard. Any sign/post damaged by the Contractor due to removal or transport shall be replaced at the sole expense of the Contractor.

The Contractor shall change the location of traffic control devices to keep them current with construction requirements.

The Contractor designate a person in his employ who shall be responsible for the inspection, repair, reinstallation, removal, relocation, or other work needed to maintain necessary traffic controls. The Contractor shall provide for inspection of all traffic controls at least once every calendar day throughout the project time. The Contractor shall keep records of this work, including, at a minimum, inspector name, date and time of inspection, and notation of all items inspected or repaired.

Shadow vehicles shall be used for brooming operations unless otherwise directed. They shall be a four-wheel motor vehicle with a flashing amber light arrow board and shall have a "ROAD MACHINERY AHEAD" sign mounted in a prominent position, visible to approaching traffic. The broom shall be equipped with a flashing amber light.

Barricades, delineators, vertical panels, cones, drums, tubular markers, and temporary road markers used to separate opposing traffic shall be bi-directional.

Traffic control devices shall be promptly removed, covered, or turned to face away from the traffic when the need for such devices no longer exists. Portable signs, which are turned to face away from the roadway, shall be moved off the shoulder area as a safety precaution. Signs shall not be visible from another travel direction.

Warning lights, when required, shall be a minimum eight inches in diameter and operate during hours when the hazard or need for regulation exists.

Warning lights may be operated singly or in groups containing more than one unit. When more than one unit is used, they shall be horizontally aligned and flashed simultaneously or vertically aligned and flashed alternately.

When used in conjunction with signs, the light shall not be located within the face of the sign nor more than 12 inches above the top of the sign. When used with barriers and channelizing devices, the beacon shall be at least three feet and not more than six feet above the pavement.

B. Temporary Pavement Marking

Temporary Pavement Marking Tape Type 1 will generally be limited to temporary striping and temporary marking on pavement that will be removed or covered with an additional lift or for other uses that do not require removal of the tape. It may also be used and subsequently removed on tangent sections along normal lane line locations.

Temporary Pavement marking Tape Type 2 will be required for all striping, involving pavement that is the final driving surface.

Temporary road markers, when used, shall be either yellow or white, as specified on the plans.

Temporary or permanent centerline marking and, on multi-lane sections, temporary or permanent lane lines, shall be placed prior to opening to traffic newly paved or roto-milled surfaces, asphalt surface treatments, seal, prime, and tack coats. Marking of edge lines are not required.

Temporary marking shall be accomplished with Temporary Pavement Marking Tape of the type specified or with Temporary Road Markers.

Temporary markings shall be of the color specified on the plans or as directed by the Engineer.

Temporary Pavement Marking Tape shall be applied in accordance with the manufacturer's recommendations. Tape used for centerline marking shall be applied in four inch width, 12 inches long at intervals not to exceed 40 feet. Solid stripes specified on the plans shall consist of tape applied in four inch widths for the length shown. Solid stripes are required for all longitudinal lines for 150 feet in advance of any traffic signal.

Temporary Road Markers shall be applied in accordance with the manufacturer's recommendations. The markers shall be applied at intervals not to exceed 40 feet when used for a centerline marking. Markers used for a required solid strip shall be applied at intervals not to exceed eight feet. Temporary Road Markers shall not be placed more than 24 hours prior to covering the in-place markings on the surface, unless otherwise allowed by the Engineer. The protective covers shall not be removed until after all oil, within two feet of them, has been applied and rolling has been completed.

Temporary markings shall be maintained in good condition until the permanent striping is in place. Temporary markings, which the Engineer determines to be no longer applicable shall be completely removed and obliterated at no expense to the City.

The City will furnish "NO PAVEMENT MARKING" signs and mileage plates for installation by the Contractor at locations shown on the traffic control plan sheets.

These signs shall be installed when striping has been obliterated. These signs, when required, shall be used in conjunction with temporary markings. Required posts, hardware, and incidentals necessary for the installation of the signs shall be furnished by the Contractor and will become the property of the City upon completion of the project. These signs will be removed, by the City after permanent pavement markings are in place.

C. Removal of Pavement Markings

Traffic stripes and pavement markings not matching current traffic flows, or as designated by the Engineer, shall be completely removed and obliterated.

Pavement markings shall be removed to the fullest extent possible from the pavement by any method that does not damage the surface or texture of the pavement. Sand or other material deposited on the pavement because of removing markings shall be removed as work progresses. Accumulations of sand or other material, which might interfere with drainage or might constitute a hazard to traffic, will not be permitted. Pavement markings shall be removed before any change is made in the traffic pattern. Covering the markings is not acceptable removal.

Where blast cleaning is used for the removal of pavement markings or for removal of objectionable material, and such removal operation is being performed within 10 feet of a lane occupied by the traveling public, the residue, including dust, shall be removed immediately after contact between the sand and the surface being treated. Removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation or by other methods approved by the Engineer.

Damage to the pavement or surfacing caused by pavement marking removal shall be repaired at the Contractor's expense by methods acceptable to the Engineer.

All construction traffic controls remaining on the site following project acceptance shall become the property of the City.

90.4 METHOD OF MEASUREMENT

Field measurement for the item "Traffic Control" will not be required.

90.5 BASIS OF PAYMENT

When an item for Traffic Control is included in the proposal, payment will be made at the lump sum contract price and shall be considered as full compensation for costs incidental thereto. Payment will be full compensation for installation, maintenance, relocation, and removal of the traffic control devices. Based on the lump sum contract price for Traffic Control, partial payments will be considered based on the following schedule:

Necessary signs furnished to site	50% of bid amount
20% of original contract amount earned	60% of bid amount
40% of original contract amount earned	70% of bid amount
60% of original contract amount earned	80% of bid amount
80% of original contract amount earned	90% of bid amount
90% of original contract amount earned	100% of bid amount

The cost of shadow vehicles, Type I and Type II barricades, cones, tubular markers, vertical panels, drums, lighting devices, flags, delineators, watchman, installation of "NO PAVEMENT MARKING" signs, and other items noted on the plans shall be included in the lump sum price bid for Traffic Control.

At locations shown on the plans to be paid for on a linear foot basis, payment for temporary markings will be made at the contract unit price per linear foot. At all other locations, the cost of temporary markings shall be included in the lump sum bid for Traffic Control. If a Traffic Control bid item is not provided, payment for these items will be absorbed in the other contract items.

The number of flagging hours will be paid for in accordance with the bid item "Flagging" as agreed to by the Engineer.

END OF SECTION

SECTION 91

TRAFFIC CONTROL DEVICES

91.1 DESCRIPTION

A. General

Signs, barricades, barrels, delineators, vertical panels and other traffic control devices, except signs or cones used only during daylight hours, shall be reflectorized with high intensity (Type III or higher) sheeting applied to a satisfactory backing. Signs, barricade, delineators and vertical panels shall be readable to the traveling public. The contractor shall certify that the sheeting meets the requirements of AASHTO M 268.

B. Related Work:

Section 90 Traffic Control
Section 92 Traffic Signals and Roadway Lighting
Section 93 Pavement Marking and Permanent Signage

91.2 FABRICATION

A. Background colors shall be as specified in Part VI of the MUTCD or as specified by the Engineer.

B. Legend

Message and borders shall be copy of the color specified in Part VI of the MUTCD. The non-removable copy may be Screened Processed or Direct Applied. Mounting holes will not be drilled or punched in any part of the non-removable copy.

1. Screened Process

Message borders shall be processed on reflective sheeting using mechanical equipment, materials and operational methods and procedures as prescribed by the manufacturer. Processing shall be accomplished by the direct or reverse screen method using opaque or transparent processing material. Screening may be accomplished either before or after application of the sheeting to the base panels. Free-hand painting will not be permitted on any part of the finished sign face.

2. Direct Applied

Cutout message and borders shall be reflective sheeting or opaque lettering film applied directly to clean, dust free, reflective sheeting background. Message and borders shall be, in accordance with the operational methods and procedures prescribed by the sheeting manufacturer. The finished letter, numerals, symbols and borders shall be cut with smooth regular outline, free from ragged or torn edges.

3. Removable copy will be allowed only if approved by the Engineer. Removable copy shall be of design so as not to become tilted or partially or wholly removed by wind, moisture, or other natural disturbances. Removable copy not bolted to the overall sign shall not be allowed during the hours of darkness.

91.3 TRAFFIC CONTROL DEVICE STANDARDS

All types of traffic control devices shall be maintained in satisfactory condition.

- A. Barricades shall conform to the requirements in Table I:

TABLE I

	BARRICADE CHARACTERISTICS		
	TYPE I (Single Rail)	TYPE II (Double Rail)	TYPE III (Triple Rail)
Width of Rail	8 in. min. - 12 in. max.	8 in. min. - 12 in. max.	8 in. min. -12 in. max.
Length of Rail	2 ft. min.	2 ft min	4 ft min
Width of Stripes*	6 in.	6 in.	6 in.
Height	3 ft. min.	3 ft. min.	3 ft. min.
No. of Reflectorized Rail Faces	2 (1 ea. direction)	4 (2 ea. direction)	3 (if facing traffic in 1 direction); OR 6 (if facing traffic in 2 directions)

*For rails less than 3 feet long, 4-inch wide stripes shall be used.

For wooden barricades, nominal lumber dimensions will be satisfactory.

Barricades may be fabricated from lumber, metal or other suitable material and shall be frangible when struck by a vehicle at 35 mph. Markings for barricade rails shall be alternate reflectorized white and orange. Stripes shall slope downward at an angle of 45 degrees from the vertical in the direction traffic is to pass.

Striping material shall be high intensity (Type III).

- B. Flashing Beacons (Flashing Electric Lights) shall be power- operated (excludes batteries) and shall follow the design specifications for standard traffic signals, which include the following.
1. Each signal unit lens shall have a visible diameter of not less than eight inches, pursuant to requirements of Part IV, MUTCD.
 2. The illuminating element, lens, reflector and visor shall render the beacon clearly visible to drivers it faces for a distance of at least 1/4 mile under normal atmospheric conditions unless obstructed.
 3. The color of the lens shall be red for a stop condition or yellow for a warning condition. The lens colors shall be in accordance with the requirements of the Institute of Traffic Engineers Standard for Adjustable Face Vehicle Traffic Control Signal Heads.

The flashing beacon shall be controlled by a device located in a separate housing unit located in a protected location. The flasher mechanism shall provide the continuous intermittent illumination of the lens or lenses of the beacon. Flashing contacts shall be equipped with filters for suppression of radio interference.

Beacons shall flash not less than 50, nor more than 60 times per minute. The illuminated period of each flash shall be not less than 1/2 and no more than 2/3 of the total cycle.

- C. Barricade Warning Lights shall be portable, lens directed, enclosed lights meeting the requirements of Table II. The lens of the unit shall not be less than seven inches in diameter and shall be amber in color. They may be used in either steady burn or flashing mode.

Barricade warning lights shall be in accordance with the requirements of "ITE Standard for Flashing and Steady-Burn Barricade Warning Lights" and MUTCD, and shall be certified by the manufacturer based on results of tests made by an independent testing laboratory.

TABLE II

	TYPE A (Low Intensity)	TYPE BI (High Intensity)	TYPE C (Steady Burn)
Lens Directional Faces	1 or 2	1	1 or 2
Flash Rate/min	55 to 75	55 to 75	Constant
Flash Duration*	10%	8%	Constant
Min. Effective Intensity**	4.0 Candela	35 Candela	
Min. Beam Candle Power**			2 Candles
Hours of Operation	Dusk to Dawn	24 hr/day	Dusk to Dawn

* Length of time that instantaneous intensity is equal to or greater than effective intensity.

** These values must be maintained within an elliptical pattern 9 degrees on each side of the vertical axis and 5 degrees above and below the horizontal axis.

Barricade warning lights shall flash (Type A or B) when mounted on a barricade or sign used to identify a hazard or hazardous condition. Signs or barricades used along a traveled way to identify a change in alignment shall have steady burn (Type C) warning lights.

D. Hazard Warning Lights, when mounted shall be as follows:

1. Barricades and portable standards
A minimum height of 36 inches from the bottom of the lens to the roadway.
2. Signs
The light shall be above the center of the sign and not be more than 24 inches above the top of the sign. The light or its housing shall not obstruct the face of the sign.
3. Vertical channelizing devices and independent supports
The light shall be a minimum height of 36 inches above the pavement.

E. Cones and Vertical Panels shall be in accordance with the following requirements:

1. Traffic cones and tubular markers of various configurations shall be a minimum of 18 inches in height for daytime use, with a broadened base and shall withstand impact without damage to themselves or to vehicles. Orange shall be the predominate color of these devices.

Traffic cones and tubular markers shall be a minimum of 28 inches in height when used on interstate highways or when used on any highway at night.

For nighttime use, cones shall be reflectorized or equipped with lighting devices for maximum visibility. Reflectorized material shall have a smooth, sealed outer surface, which will display the same color day and night.

Reflectorization of tubular markers shall be a minimum of two, 3-inch white bands placed a maximum of two inches from the top with a maximum of six inches between the bands. Reflectorization of cones shall be provided by a minimum 6-inch white band placed a maximum of three inches from the top and a 4-inch white band spaced a minimum two inches below the 6-inch band.

2. Vertical panels shall be 8 to 12 inches in width and a minimum of 24 inches in height. The stripes shall be alternating reflectorized white and orange slanting downward at 45° degrees from the vertical toward the side on which traffic is to pass. For panels less than three feet in height, 4-inch stripes shall be used.

Mounting shall be on a single, frangible or breakaway support assembly. The mounting and base support shall be constructed to minimize hazards to motorists.

The panel shall be mounted with the top a minimum of 36 inches above the roadway.

- F. Mounting posts for construction signs shall yield upon impact to minimize hazards to motorists and shall be of a height adequate to properly display the signs. Wood posts with a cross sectional area greater than 24 square inches shall be drilled to provide breakaway capability.

Portable frames for mounting traffic control signs may be used where sign mobility is required. The portable frames shall provide a minimum sign mounting height of 1 foot above the roadway and shall be frangible when struck by a vehicle at 35 mph.

- G. Pilot cars shall be four-wheel motor vehicles with appropriate signing.
- H. Temporary Pavement Marking Tape shall be provided on all roads open to traffic and shall be applied in accordance with the manufacturer's recommendations and meet the following requirements:
 1. Temporary Pavement Marking Tape - Type 1 shall consist of a retro-reflective film on a conformable backing, pre-coated with a pressure sensitive adhesive. The adhesive shall retain the tape on the pavement under project traffic and climatic conditions for required service life for the project. The film shall retain retro-reflective characteristics during the required service life.
 2. Temporary Pavement Marking Tape - Type 2 shall meet physical requirements of Temporary Pavement Marking Tape Type 1 and shall be removable without scarring

or damaging the roadway surface. The contractor shall provide assurance that the tape is removable as noted on product literature or through field-testing.

- I. Temporary Road Markers shall consist of a yellow or white plastic body providing a vertical area + 3 1/2 inches in width and + 2 inches in height with an adequate base for bonding to the pavement.

A strip of reflective tape 1/4-inch minimum width shall be bonded horizontally along the top of the vertical area.

The marker shall yield when contacted by a vehicle tire and return to a vertical position after the tire has passed over it.

The marker base shall be provided with an adhesive to securely bond the marker to the pavement. The adhesive shall be resistant to the effects of weather and capable of retaining the marker in position during the time it is required to function.

The plastic shall be polyurethane or other suitable plastic material.

The reflective tape shall be acrylic baked metalized polycarbonate micro prism retro-reflective material or equal. The tape shall have a minimum reflectance of 1,800 candlepower per foot-candle per square foot at 1/10 degree observation and 0-degree entrance angle.

91.4 METHOD OF MEASUREMENT

Field measurement for the item "Traffic Control Devices" will not be made.

91.5 BASIS OF PAYMENT

When an item for Traffic Control is included in the proposal, payment will be made at the lump sum contract price and shall be considered as full compensation for costs incidental thereto. Payment will be full compensation for installation, maintenance, relocation, and removal of the traffic control devices.

END OF SECTION

SECTION 92

TRAFFIC SIGNALS AND ROADWAY LIGHTING

92.1 DESCRIPTION

A. General

This work consists of furnishing and installing roadway lighting and traffic signals and components. All existing roadway lighting and traffic signal components not reused shall remain the property of the City and shall be salvaged to the City of Rapid City Steele Avenue yard in good condition.

B. Related Work

Section 90 Traffic Control
Section 91 Traffic Control Devices
Section 93 Pavement Marking and Permanent Signage

92.2 MATERIALS

A. Electrical Grounding and Bonding

1. Grounding wire from electrical cabinets to the ground rod shall be bare, soft drawn copper, sized per NEC. Grounding wire from pole to ground rod shall be bare, soft drawn copper, minimum size No. 6 AWG.
2. Bonding conductors shall be of the same size and insulation grade as the associated circuit conductors. Load size bonding jumpers shall not be smaller than the applicable size listed by the NEC, Table 250-95.
3. Ground rods shall be copper-coated electrodes in accordance with UL. The size and length shall conform to NEC requirements.

B. Electrical Conduit

1. Rigid steel conduit and fittings shall meet the requirements of UL 6 and 514 and shall be hot-dip galvanized. Each section of conduit shall bear the UL label.
2. Rigid non-metallic conduit and fittings shall be polyvinyl chloride heavy wall meeting the requirements of UL 651 and 514. Use and installation of PVC Schedule 40 and 80 shall be in accordance with NEC Article 347, and each section shall bear the UL label. If non-metallic conduit is to be used in areas subject to vehicular traffic, it shall be Schedule 80.

3. Intermediate metal conduit and fittings shall conform to the requirements of the UL, and each section of conduit shall bear the UL label. Intermediate conduit shall be galvanized on the outside surface.

C. Junction Boxes

1. Junction boxes shall be of a non-metallic material and conform to National Electrical Code standards 314.29 and 314.30. The word "ELECTRIC(AL)" shall be cast into the top of the cover.
2. Surface-mounted boxes shall be a non-corrosive metal box with a NEMA rain-tight lid designed for mounting on any surface to which a conduit can be attached. The box shall be a manufactured electrical box suitable for accepting conduit junctions, electrical wire splices and for use as a pulling facility for electrical wire.

D. Concrete Footings

Concrete for footings shall meet the requirements for Class M6 concrete. Cement shall be Type II. Vertical reinforcement shall be Grade 60 and shall conform to the requirements of ASTM A 615. Circular ties, stirrups and spiral reinforcing may be fabricated from cold drawn wire ASTM A 82 or hot rolled plain or deformed bars conforming to the strength requirements of ASTM A 615 grade 60. Anchor bolts shall conform to requirements specified in Section 92.2 E.

E. Anchor Bolts

Anchor bolts for lighting poles and mast arm signal poles shall be per pole manufacturer's design. Only rolled threads may be used. The nuts, washers, and at least 3 in. plus the threaded length of the threaded end shall be galvanized in accordance with ASTM A 153.

Anchor bolts for pedestal signal poles and cabinets shall be per the manufacturer's design.

F. Electrical Power Cable

1. Electrical cables shall be rated for 600 VAC and be clearly and durably marked with the UL label, type of insulation, number of conductors and AWG size.
2. Traffic signals and traffic signals with intersection lighting using the same service cabinet shall utilize stranded copper meeting the requirements of ASTM B3 and B8, Class C.
3. Roadway lighting shall utilize stranded conductors of aluminum or copper for service, feeder and branch circuits.

4. All underground wire shall be installed in conduit.
5. All wire #2 AWG or smaller shall be factory colored as follows to reflect the application:

White for grounded conductor;
Green for grounding conductor; and
Red and black for ungrounded conductors.

6. Pole and Bracket Cable

The cable from pole base to luminaire shall be two-conductor of the AWG size shown, meeting ICEA standards.

Conductors shall be stranded bare soft copper meeting ASTM B3 and B8, Class C. Each conductor shall be insulated with high dielectric strength heat and moisture-resistant polyvinyl chloride rated for use at 75 degrees C and shall meet the requirements of ICEA S-61-402 Section 7.1.3 and subsequent revisions. One insulated conductor shall be colored white and the other black. The two insulated conductors shall be laid parallel and covered with a black polyethylene belt. The belt shall meet the requirements of ICEA S-61-402 Section 7.1.5 and subsequent revisions.

G. Electrical Service Cabinet

The electrical service cabinet shall:

- Meet NEMA standard for rain-tight;
- Be equipped with a lock and two keys;
- Sized as required to house required components; and
- Be rated for service entrance equipment.

The following components are required:

- Main breaker
- A copper bus rated for the voltage, current, and phases required by the plans
- Branch circuit breakers meeting plan requirements for amps, voltage, and phases. Minimum A.I.C. shall be 10,000
- When fused disconnects are required, the disconnects shall be rated for the voltage and current shown on the plans and shall be UL rated.
- When plans require, a mechanically-held contactor, NEMA-rated for the load served, shall be provided. The contactor shall be encased in a UL approved weatherproof housing with an integral test switch included. The contactor shall be complete with an interface relay for photocell control and photocell by-pass switch. A photocell shall be provided.

H. Luminaires

1. Must be a complete lighting device, weatherproof, with cast aluminum housing, reflector, refractor, lamp, lamp socket, terminal block, integral ballast and with internal parts readily accessible.
2. Mounting must be by a 2 in. slip fitter (except for wall mounts).
3. Refractor shall be constructed of clear, heat- and shock-resistant glass or material, which gives similar light transmission with superior shock resistance.
4. Ballast shall be constant-wattage and multiple-voltage.
5. Wall mount luminaires must be vandal-resistant.

I. Photoelectric Control Requirements

1. The photoelectric cell shall meet EEI/NEMA and ANSI C136-10 standards and subsequent revisions, and shall have an outside diameter of three in.
2. The housing shall be non-metallic and weatherproof and the cover must be ultraviolet light stabilized and impact-resistant.
3. The load switch must be an electromagnetic relay.
4. Mounting shall be to an EEI/NEMA three-terminal, polarized, twist-lock-type receptacle.
5. Shall operate on any electrical power between 105 and 285 volts, 50 to 60 hertz alternating current.
6. Shall be equipped with an expulsion-type arrester for surge protection.
7. Shall have a minimum of three seconds time delay to eliminate false operation due to lightning or stray passing lights.
8. Shall provide for fail-safe operation. The light shall remain "ON" if the control fails.
9. Factory set to turn on at 1.0 foot-candles and off at 3.0 foot-candles.

J. j. Roadway Lighting Poles

1. Design and Fabrication
 - a. Design and fabrication shall be in accordance with "AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and plan details. Design shall also include provision for the mounting of a 30 in. x 36 in. sign located 10 feet above the base.

- b. The design wind velocity shall be 80 mph and the gust factor 1.3.
 - c. The design yield strength for steel shall be no higher than 55,000 psi. Yield strength of the steel used in fabricating poles may be higher than 55,000 psi but shall not be lower than 36,000 psi.
 - d. Transformer base poles shall be provided and all poles on a contract must be of the same type.
 - e. Anchor bolt circle, anchor bolt size and other structural properties of the pole and base are to be designed and determined by the pole manufacturer.
 - f. Pole designs must provide for drainage with no laps or edges to hold moisture.
 - g. Mast arm pole shafts shall have a removable cover and an opening for cable entrance to the mast arm.
 - h. A cable strain relief connector shall be provided at the point of entrance to the mast arm or electrical fixture.
 - i. Hand holes and other openings shall be smooth and neat. A 1/2 inch nut shall be welded inside the hand hole for grounding purposes. The weld shall not show through to the outside.
 - j. A junction box shall be provided within two feet of the base of the pole with conduit running from the J-box into the pole housing.
2. A statement is required, signed by a Registered Professional Engineer, certifying that the pole designs meet all plan and specification requirements.
 3. Three copies of shop drawings, design calculations and certifications for poles shall be furnished. The Engineer shall retain one copy, submit one copy to the Traffic Engineer for review and submit the third copy to the maintaining authority.

K. Traffic Signal Poles

1. Design and Fabrication

- a. The location, number, area and weight of the signal heads as shown on the plan detail plates shall be used for determination of adequate mast arm, pole and footing structural design. The actual quantity and locations of signal heads shall be as shown on the plan sheet.
- b. The design shall also include provisions for:

One mast arm mounted street name sign (18 inches x 72 inches minimum); One additional mast arm mounted sign (30 inches x 36 inches) for each 10 feet of mast arm length; One pole mounted sign (30 inches x 36 inches) located 10 feet above the base; and Preemption and video detection equipment.
- c. Design and fabrication shall be in accordance with "AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" and plan details.
- d. The design wind velocity shall be 80 mph and the gust factor 1.3.
- e. The design yield strength shall be no higher than 55,000 psi. Strength of steel for fabricating poles may be higher than 55,000 psi but not lower than 36,000 psi.
- f. Transformer base poles shall be provided and all poles on a contract must be of the same type.
- g. Anchor bolt circle, anchor bolt size and other structural properties of the pole and base are to be designed and determined by the pole manufacturer.
- i. Pole designs must provide for drainage with no laps or edges to hold moisture.
- j. Mast arm pole shafts shall have a removable cover and an opening for cable entrance to the mast arm.
- k. Luminaire extensions shall meet specifications for Roadway Lighting Poles.
- l. Hand holes and other openings shall be smooth and neat. A 1/2 inch nut shall be welded inside the hand hole for grounding purposes. The weld shall not show through to the outside.
- m. All poles shall be designed with rotateable arms.

- n. A cable strain relief connector shall be provided at the point of entrance to the mast arm or electrical fixture.
 - o. The end of all mast arms shall be internally accessible through a hand hole.
2. A statement is required, signed by a Registered Professional Engineer, certifying that the pole designs meet all plan and specification requirements.
 3. Three copies of shop drawings, design calculations and certifications shall be furnished. The Engineer shall retain one copy, submit one copy to the Traffic Engineer for review and submit the third copy to the maintaining authority.

L. Traffic Signal Control Cable

1. Multiple Conductor Cable shall be THHN/THWN insulated conductors with fillers of non-absorbent material, bound with polyester tape and with a polyvinyl chloride jacket. Two-conductor cables may be either round or flat construction.
2. Conductors shall be Class C stranded copper meeting the requirements of ASTM B3 and B8.
3. Insulation shall have a minimum thickness of 19 mils, of which 15 mils shall be polyvinyl chloride with the remaining thickness of nylon.
4. Conductor insulation shall be colored in accordance with ICEA S-61-402, Method 1, Table K-2.
5. Jackets shall be polyvinyl chloride meeting UL requirements for Class 12 jackets and ICEA S-61-402 Section 4.3.1, thickness per Table 4.5
6. The cable shall be marked with the manufacturer's name, rated voltage, UL label, AWG size and number of conductors.

M. Traffic Signal Controller & Cabinet Assembly

All traffic signal controller units shall be equipped with a communication module and operating software that is fully compatible with the master controllers and central software systems currently owned and utilized by the City in the operation of its signal network.

1. NEMA TS1 Type 1

a. Controller

1. The controller shall be a solid state, digital, NEMA TS1 Type 1.
2. Controllers shall be two through twelve phase controllers.

3. The controller unit shall provide preemption capable of containing up to six distinct sequences, including low priority sequences.
4. Vehicle detectors shall operate in the presence (non-locking) mode and shall have call delay timing capability. This call feature shall be inhibited by the controller.
5. Digital timing shall be provided with battery backup.
6. The controller may alternate the red and yellow indications when flashing or flash all-red.
7. The controllers shall be capable of programming by manual entry via the front panel keyboard, data down loading via null-modem cable, and data down loading from controller to another via serial port connection.
8. The controller shall be capable of operating coordinated by time-based, hardwire and telemetry.
9. The controller shall have a copy function to copy all timing data from one phase to another. The controller shall also permit copying all coordination pattern data from one pattern to another.
10. The controller shall have internal signal dimming.
11. The controller solid state flasher shall have dimming capability.
12. The City is responsible for programming controllers with the signal timings shown on plan sheets.
13. The controller shall be equipped with a police push button with appropriate length of cable.
14. The controller or the conflict monitor shall record significant events and then generate a report from data logged. Monitor status bits shall be on the back panel. Reports shall be transmitted to an external printer or portable computer using the RS232 port on the front of either unit. Data records shall be time and date stamped and shall include, as a minimum, the following types of records:
 - Power on/off, interruption
 - Power on self-test diagnostics pass/fail
 - Conflict Monitor Status (Conflict, Red Fail, etc.)
 - On/off status of 8 user defined inputs

- Remote Flash on/off
- Manual control Enable on/off
- Start and end of each pre-empt sequence
- Cycle failure
- Enter/exit system operation
- Flasher failure (2 AC inputs)
- Detector 1-24 out of threshold
- Detector 1-24 no activity
- Detector 1-24 constant call
- Detector 1-24 Return to normal
- Phase 1-8 in/out of Detector Max Fail Recall mode

b. Cabinets

1. General

- 1) Controller cabinets shall meet the requirements of NEMA TS1.
- 2) The controller cabinet shall be made of sheet aluminum alloy and be mounted as shown in the plans. It shall be a Type P cabinet with minimum dimensions of 55 in. H x 44 in. W x 26 in. D. It shall have the following features and accessory equipment:
 - i. Unpainted natural aluminum finish.
 - ii. Gasketed main door (right side hinged) with standard lock and two keys and doorstop.
 - iii. Gasketed police panel door with police lock, 2 keys, flash switch and signal shutdown switch. At any switch position, power shall be maintained on all control equipment, including detector amplifier units, within the cabinet. The switch shall be labeled and rated for the current load. Switch terminals on the rear of the police panel shall be insulated so live parts are not exposed.
 - iv. Thermostatically controlled fan installed in plenum in roof of cabinet. Turn-on temperature adjustable between 70° and 160°F and shall be separately fused.

- v. Filtered air intake of at least 12 square inches near the bottom of the cabinet, designed to prevent the entrance of dust, insects and blowing rain and snow. Filter removable for cleaning or replacement.
 - vi. Solid state dimmable flasher conforming to NEMA Standard TSI Part 8, Type 3. Heavy duty flash transfer relays shall be provided.
 - vii. Solid state load switches conforming to NEMA Standard TSI Part 5 shall be provided in sufficient numbers to provide the sequence shown in the plans.
 - viii. Dual ring, 12-position back panel.
 - ix. Maintenance switches inside the cabinet shall include the following:
 - a) Stop Time Control
 - b) Timer Power
 - c) Flash
 - d) Vehicle detector input for each phase in use
 - e) Pedestrian input for each phase in use
 - x. Loop detector amplifiers and harnesses shall be furnished in sufficient quantity to accommodate the detector loops as shown in the plans. They shall be 4-channel units with LCD displays, Model U-1200 as manufactured by Reno A&E.
 - xi. A 12-channel conflict monitor shall be provided. It shall conform to NEMA TSI-1989 and be equipped with an LCD display, keyboard and event logging features.
 - xii. Anchor bolts (set of 4).
- 3) A 6 inch square vinyl decal shall be provided on the cabinet door showing the intersection layout, signal phasing with phase numbers and detectors.

2. Electrical

- 1) Duplex receptacle with ground fault interrupter, lamp base with toggle switch. Outlet and lamp to be fused ahead of the main circuit breaker. A non-GFI receptacle shall also be provided and mounted near the controller shelf.
- 2) A main circuit breaker shall be furnished and installed in the controller cabinet. An auxiliary circuit breaker shall be provided and connected to the load size of the main breaker. The main breaker shall be wired to protect the signal load and controller circuits. The auxiliary circuit breaker shall be properly rated and fused to protect circuits utilizing unfiltered AC power.
- 3) Terminal facilities in the cabinet for incoming AC power will be protected to prevent short-circuiting when working with tools in the cabinet. The circuit breakers shall be capable of manual operation with markings to indicate ratings and whether it is in the open or closed position.
- 4) A power line filter meeting the following specifications shall be installed at the main breaker:
 - 50db minimum attenuation over a frequency range of 200 kilohertz to 75 kilohertz.
 - Hermetically sealed in a metal case.
 - Minimum feed-through current of 30 amperes at 120 volts, 60 hertz.
 - A minimum of a ¼ in. current path between input-output terminals and the metal case.
 - Power input and output connections are made to 10-24 brass studs.
 - An insulation factor between the line circuit and the metal case (ground) of 100M to 200M ohms.
- 5) Surge protection for dissipating line transient voltages shall be furnished and installed using a metal oxide vaistor rated at 20 joules with a 150-volt r.m.s. clipping voltage connected between each 120 VAC input line and AC common at the main breaker.

- 6) The 120 VAC power feed at the entrance to the controller cabinet shall be protected against lightning by a rare gas arrester. The arrester shall be located in advance of both the surge protector and the main circuit breaker, be properly grounded and conform to the following:
 - Replaceable, self-restoring, rare gas cartridge with hermetically-sealed metal electrodes;
 - Induction discharge period in excess of 5 amperes r.m.s. for 2 minutes or 25 amperes r.m.s. for one second or 15 amperes r.m.s. for 10 seconds, all followed by complete restoration to original characteristics.
 - Discharge voltage minimum of 200 volts.
 - Mounted on a standard AAR porcelain base equipped with a spark gap discharge feature.
- 7) Bus bar terminals such as AC common (neutral), AC power, safety (chassis) ground and AC signal power shall be furnished and properly installed.
- 8) Terminals and panel wiring for detector leads, interconnect, time switches, relays, load switch sockets, flash transfer relay sockets and any other components required to provide the controller operation shall be installed.
- 9) Terminals and components that make up the basic terminal facilities shall be permanently identified in accordance with the cabinet wiring diagram. Identification shall be permanently attached as close as possible to the terminal or component and shall not be affixed to any part that can easily be removed.
- 10) Each input or output terminated on a terminal block, shall be identified on the front of the panel by a position number and functional terminology (e.g. 0/1 Red, 0/2 Hold, Channel 3 Red, etc.). The same identification shall be used consistently on the cabinet wiring diagram.
- 11) Each component shall be identified on the front of the panel by a symbol and function terminology consistent with the cabinet wiring diagram. Provisions shall be made that each load switch socket may be identified by the phase or overlap

number by writing on the panel in an area established for this feature.

- 12) Panel wiring shall be neat and firm with panel-mounted terminals for signal lamp circuit conductors, one for each signal circuit and one or more terminals for the common conductor. The terminals shall be located a minimum of three inches from the bottom of the cabinet and arranged for adequate clearance between the terminals. The controller equipment and terminals shall be arranged within the cabinet so they will not upset the entrance, training and connection of incoming conductors.
- 13) Interface panels shall receive twelve (12) load switches.
- 14) Controller cabinets shall be equipped with a detector test push button panel to place vehicle and pedestrian calls into the controller. Push buttons shall provide for eight (8) vehicle phases and four (4) pedestrian phases. The push buttons for vehicle phases shall be capable of extending the associated phase by intermittent or continuous contact.

2. NEMA TS2 Type 1

a. Controller

1. The controller shall be a solid state, digital, NEMA TS2 Type 1.
2. Controllers shall be two through twelve phase controllers.
3. Vehicle detectors shall operate in the presence (non-locking) mode and shall have call delay timing capability. This call feature shall be inhibited by the controller. Vehicle detectors shall be set to a three (3) second delay.
4. Digital timing shall be provided with battery backup.
5. The controller may alternate the red and yellow indications when flashing or flash all-red.
6. The controllers shall be capable of programming by manual entry via the front panel keyboard, data down loading via null-

modem cable, and data down loading from controller to another via serial port connection.

7. The controller shall be capable of operating coordinated by time-based, hardwire and telemetry.
8. The controller shall have a copy function to copy all timing data from one phase to another. The controller shall also permit copying all coordination pattern data from one pattern to another.
9. A malfunction management unit (MMU) shall be installed in each cabinet and shall conform to NEMA Standard TS2, Section 4.
10. The controller shall have internal signal dimming.
11. The controller solid state flasher shall have dimming capability.
12. The City is responsible for programming controllers with the signal timings shown on plan sheets.
13. Controllers shall be equipped with a police push button with appropriate length of cable.

b. Cabinets

1. General

- 1) Controller cabinets shall meet the requirements of NEMA Standard TS2.
- 2) A 6 inch square vinyl decal shall be provided on the cabinet door showing the intersection layout, signal phasing with phase numbers and detectors.
- 3) A sufficient quantity of BUS interface units (BIU) shall be installed in the cabinet to provide communication between detectors, load switches, controller unit, etc. Each BIU shall conform to NEMA Standard TS2, Section 8.
- 4) The cabinet shall be constructed from type 5052-H32 aluminum with a minimum thickness of 0.125 inches. The cabinet shall be supplied with a natural aluminum finish. Sufficient care shall be taken in handling to ensure that scratches are minimized. All surfaces shall be free from weld flash. Welds

shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.

- 5) The eight phase cabinet shall consist of a size 6 cabinet.
- 6) All seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
- 7) The front edge of the shelves shall have holes punched every 6 inches to accommodate tie wrapping of cables/harnesses.
- 8) The main door hinge shall be a one-piece, continuous piano hinge with a stainless steel pin running the entire length of the door. The hinge shall be attached in such a manner that no rivets or bolts are exposed.
- 9) All 8-, 12- and 16-position main panels shall be hinged at the bottom to allow easy access to all wiring on the rear of the panel.
- 10) All load switch and flash transfer relay socket reference designators shall be silk-screen labeled on the front and rear of the main panel to match drawing designations. Socket pins shall be marked for reference on the rear.
- 11) Field terminal blocks shall be wired to use four positions per vehicle or overlap phase (green, yellow, red, flash). It shall not be necessary to de-bus field terminal blocks for flash programming.
- 12) All main panel wiring shall conform to the following wire size and color:
 - i. Green/Walk load switch output, brown wire, 14 gauge
 - ii. Yellow load switch output, yellow wire, 14 gauge
 - iii. Red/Don't Walk load switch output, red wire, 14 gauge
 - iv. MMU (other than AC power), violet wire, 22 gauge
 - v. Controller I/O, blue wire, 22 gauge

- vi. AC Line (power panel to main panel), black wire, (1 for each 4 LS), 10 gauge
 - vii. AC Line (main panel), black wire, 14 gauge
 - viii. AC Neutral (power panel to main panel), white wire, 10 gauge
 - ix. Flash programming, flasher socket to terminal, orange wire, 14 gauge – flasher socket to red or yellow field terminal, black wire, 14 gauge
 - x. Earth ground (power panel), green wire, 8 gauge
 - xi. Logic ground, grey wire, 22 gauge
- 13) The main panel shall incorporate a relay to remove +24 VDC from the common side of the load switches when the intersection is placed into flash. The relay shall have a momentary pushbutton to apply power to the load switch inputs for ease of troubleshooting.
- 14) All test switch panel wiring shall be connected to the main panel via a multiple pin type connector.
- 15) The power bus assembly shall be manufactured from 0.009", 5052-H32 aluminum. It shall provide filtered power for the controller, MMU, cabinet power supply, and all auxiliary equipment. It shall include the SDLC bus connecting cables wired into a surface mounted compression terminal block. It shall have six power connectors.
- 16) The cabinet shall be assembled and tested by the controller manufacturer or authorized local distributor to ensure proper component integration and operation.
- 17) Any defects shall be corrected by the manufacturer or supplier at no cost to the City.

N. Emergency Vehicle Preemption

1. System Description

- a. This specification describes the minimum operating requirements of a siren activated emergency vehicle preemption system. The vehicle siren, which is standard equipment on all emergency vehicles, registers its presence by activation of the siren's "yelp, hi-lo, wail" modes. The system provides a method that allows an emergency vehicle to have priority over other vehicles and pedestrians at a traffic signal. All approaches to a signal serving vehicular traffic shall be equipped to provide priority to emergency vehicles. Under no circumstances shall any vehicular approach to a signal be unprotected. The system components are as follows:
 - 1) Detectors - directional microphones at each approach to the signal that detect the imminent arrival of an emergency vehicle.
 - 2) Phase selector - located in the signal controller cabinet. It processes the input detector information and produces an appropriate output to the signal controller.
 - 3) Emitters - the existing electronic siren on each vehicle. Any electronic siren that meets current federal standards is compatible with the system. Sirens are not to be furnished as part of this project. The system shall be expandable to include sirens that generate an embedded vehicle identification code that may be acquired in the future.
- b. The signal controller shall be programmed for the special preemption sequence as shown in the plans. If shown on the plans, a confirmation light shall be installed on each approach that informs the driver whether the signal actually is under preemption control rather than normal operation.

2. Detector Devices

- a. The detectors shall be specially designed microphones that are positioned on the traffic signal poles in such a manner that each approach to the signal is adequately detected. They shall be weatherproof and designed to withstand electrical transients normally encountered in the ambient outdoor environment. The detectors shall not be affected by fog, rain, ice, snow or other adverse weather conditions. The close proximity of high profile vehicles, e.g. large trucks, to an emergency vehicle shall not present a shield or barrier to the acoustical energy emitted from the siren. They shall be directional with an 18° cone of sensitivity and a polar curve of 9:1 (front to side). Electrical cable from the detector to controller cabinet shall be 18 AWG (minimum) 2-conductor, twisted, shielded pair such as Belden 8760 or equal.
- b. Detectors shall be located as shown in the plans and shall be installed in strict accordance with the manufacturer's recommendations.

3. Phase Selector Device

- a. The electronic device located in each signal controller cabinet is commonly referred to as a phase selector. This device is used to decode the information from each detector and produce suitable outputs to the controller. It shall be designed to meet the environmental and electrical standards specified by NEMA Standard TS1 or TS2. It shall be designed using microprocessor circuitry and shall be fully compatible with NEMA TS1 and NEMA TS2 controllers and cabinet assemblies.
- b. Adjustment and calibration of the EVP system shall be a function of detector placement and phase selector inputs. The phase selector shall have resident software that allows range and sensitivity adjustments to be made using a portable computer.
- c. The phase selector shall have adequate memory to record all system activity. Each access to the system shall be recorded with the date, time, duration of access, quality of the emitter/detector input signal, along with any other pertinent information. There shall be sufficient memory to store no less than 5,000 usage events. The event log shall be accessible by direct connection of the unit to a portable computer. (The portable computer shall not be furnished as part of this project.)

4. Technical Support Services

The manufacturer and/or supplier shall provide the initial setup and make adjustments that assure proper operation of the system. Technical training to the City shall be provided as necessary.

O. Video Detection System

1. Cameras

Cameras used in video detection systems shall be Autoscope Solo[®] Pro or approved equal. Any "approved equal" shall be approved by the City and will be considered experimental for a 12-month period following installation. City acceptance of any "approved equal" will not occur until such units have been deemed to have operated successfully for the 12-month experimental period.

2. Equipment, Cables and Software

All associated video detection equipment and cabling shall be approved by the camera vendor or as accepted by the City.

System software shall be compatible with Autoscope Solo[®] Pro software.

3. Warranty

The video detection system shall be warranted by its supplier for a minimum of two years. The warranty period for "approved equals" shall not commence until formal acceptance by the City.

P. Vehicle Detector Loops

1. Feeder wires from loop leads to detector units shall be RENO A & E LW-216 or approved equivalent twisted shielded pair wire. Splices are to be avoided in feeder wires where possible and are allowed only in junction boxes.
2. Unless otherwise specified on the plans, factory preformed loops shall be installed.
 - a. Preformed loops shall be constructed using 9.5 mm (3/8 inch) I.D. polypropylene.
 - b. Conduit shall be completely filled with a material specifically designed to withstand the heat of asphalt pavement construction, while retaining flexibility and protecting the encapsulated wires.
 - c. Wire lead-ins shall be twisted a minimum of 4 times per foot of length.
 - d. Lead-ins shall be attached to loop leads with Schedule 80 CVPC fittings.
 - e. All lead-ins shall be filled with a material specifically designed to withstand the heat of asphalt pavement construction, while retaining flexibility and protecting the encapsulated wires.
 - f. All wire runs shall be continuous through the loop and lead-ins.
 - g. All loops shall be tested at the factory prior to shipment. Testing documentation shall be provided to the Engineer prior to final acceptance.

3. Contractor Fabricated Preformed Loops

When approved by the Engineer for applications in which the loops will not be in direct contact with hot asphalt, non-factory manufactured preformed loops may be acceptable. Non-factory manufactured preformed loops must meet the following criteria:

- a. Wire type shall be 14 ga. XHHW-2.

- b. Loop wire and lead-in wire shall be enclosed in ½ in. Sch. 40 PVC conduit. Fittings shall be Sch. 40 PVC, and all joints shall be waterproof.
 - c. The tee, at the junction of lead-in conduit to loop conduit, shall be filled with a waterproof silicone sealant.
4. Sawed-In Loops
- a. Backer rod material shall be resilient, non-absorbent material approximately 25% larger in diameter than the width of the sawed slot to be sealed.
 - b. The flexible embedding loop sealer shall be Preco Gold Label Flex, or approved equal.
 - c. Wire type shall be RENO A & E LW 116-S or approved equivalent.
 - d. An extension from the loop to the pavement edge permitting wire routing to an adjacent pull box shall be considered as part of the work required for a sawed-in loop.

Q. Q. Signal Heads

1. Vehicular and pedestrian signals shall be manufactured in polycarbonate sections. All sections shall be interchangeable and shall fit so they can be combined in a tier. Each section shall be of rugged, durable design using reinforcing ribs in both top and bottom as well as the interior of the housing.

External reinforcing plates shall not be necessary for structural integrity and any requirement or recommendation by the manufacturer for the use of such plates shall be considered evidence of inferior design and cause for rejection. The mounting devices, lens indications, and other modifications shall be as shown in the project plans.

2. Pedestrian signals shall be constructed with both indications in a single housing. Pedestrian indications shall be 12 in. universal symbols.
3. Unless otherwise shown in the project plans, all signal indications shall be nominal 12 in. diameter.
4. All signal and pedestrian indications shall be light emitting diode (LED) modules. The LED modules shall meet or exceed the current Institute of Transportation Engineer's LED standard
5. Each circular signal section shall be furnished with a tunnel type visor and shall be attached to the door front using four (4) stainless steel screws, which shall thread into a brass thread insert.

6. A suitable terminal block shall be provided in each signal assembly to terminate socket wires with incoming field circuits.
7. A back plate shall be furnished with each vehicular signal face forming a 5-inch border around the perimeter of the signal. Back plates shall be one-piece, louvered, vacuum formed ABS plastic. The bottom segment shall be split for ease of installation and joined with stainless steel screws. The side exposed to traffic shall have a dull or hair cell finish. 3-section signals shall use a 2-piece, non-louvered plastic back plate. The plastic material shall be 0.125 in. thick flat polyethylene with ultra-violet inhibitors. The side exposed to traffic shall have a dull finish.
8. Signal head bodies shall be federal yellow in color. Door, visors, and backplanes shall be dull black.
9. Signals mounted on mast arms shall utilize a universally adjustable mast arm Astrobrac mounting assembly. It shall be unpainted aluminum or galvanized finish.
10. Signals mounted on side of pole or top of pedestal pole shall use industry standard locking brackets made from 1 ½ in. aluminum pipe and appropriate locking fittings. Attachment to signal heads shall be with tri-stud type hardware. Exposed pipe and hardware shall be painted federal yellow.
11. Vehicular signal heads must meet requirements of the ITE Standard: "Vehicle Traffic Control Signal Heads". Pedestrian signal heads must meet requirements of the ITE Standard: "Pedestrian Traffic Control Signal Indications".
12. Signal heads shall be mounted at a ninety (90) degree angle to the road surface.

92.3 CONSTRUCTION REQUIREMENTS

A. General

1. The contractor shall furnish and install all material and equipment for Traffic Signals and Roadway Lighting as required by the plans and specifications.
2. Equipment and materials furnished shall be new.
3. The Contractor shall contact all utility companies to determine their involvement within the project limits and to notify them of the date that work is to begin. The Contractor shall contact the One Call Center at least 48 hours prior to excavating.
4. All work shall be in compliance with City, local utility, and NEC requirements (latest revisions).

B. Underground conduit

1. Conduit shall be placed by jacking, drilling, or trenching. Trenching under existing pavements will only be allowed with the approval of the Engineer.
2. Conduit entering through junction or pull box walls shall terminate approximately two inches in from the inside wall and not less than two inches above the bottom.
3. Conduit entering the traffic signal cabinet shall be sealed with paraffin or other approved sealing compounds to prevent the entrance of gases.
4. Nonmetallic conduit open ends shall have an approved bell end or bushing installed to prevent damage to cable or conductors.
5. Metal conduit open ends in junction boxes or above concrete foundations shall be provided with an approved threaded conduit grounding bushing.
6. Metal conduit ends shall be reamed to remove sharp edges and burrs. Threads on threaded conduit shall be painted with a good quality lead or rust preventive paint as the couplings are made up. Couplings shall be tightened until the ends of the conduit are brought together.

C. Junction boxes

1. Eighteen (18) inches of Type 2 Select Granular Backfill material shall be placed below the bottom of the junction box as foundation.
2. The top of the junction box shall be flush with hard-surfaced areas and approximately one inch above earth or grass areas.

D. Concrete Footings

1. The bottom of concrete footings shall rest on firm ground. The sides of the footings shall be formed by using an auger and then placing the concrete against undisturbed soil.
2. A suitable form shall be used above existing ground line and all exposed portions shall be formed to present a neat appearance. The above ground portion of the footing shall be formed of sufficient size and shape so no part of the pole or transformer base shall overhang or protrude beyond the footing.
3. An acceptable form shall be used if the excavation is larger than the standard footing dimensions. Backfill or a flow able fill must be placed to a density equal to or greater than adjacent undisturbed natural soil.

E. Underground Wire Installation

1. General

- a. All underground wire installations shall run in conduits. No wire shall be pulled through a conduit housing existing wire. In such cases, all wire shall be removed and new wire installed.
- b. Wire shall be installed using methods that will not injure the jacket, insulation, or conductors.

2. Traffic Signal Cable

- a. There shall be no splices from controller to poles.
- b. There shall be six (6) feet of cable slack provided in junction boxes.
- c. Cable runs shall include a seven (7) conductor cable to the end of all overhead mast arms.
- d. Cables pulled to the base of all signal poles shall have a minimum of twelve (12) spare conductors.
- e. Cable terminations in pole bases shall use 3M™ Scotchlok™314 wire connectors.
- f. Wires from signal heads shall be labeled with cloth type labels.
- g. All wires entering the controller cabinet shall be color coded to each corner and bundled neatly.

F. Loop Detectors

1. General

- a. Loop wire shall be continuous throughout the loop and lead-ins.
- b. All wire connections shall be sealed and insulated with 3M™ Scotchcast™ 3570G Connector Sealing Packs.
- c. The lead-in wires, from the loop to the junction box, shall have a minimum of three (3) twists per foot.
- d. Loop lead-ins shall extend to a junction box. Lead-ins shall be long enough to provide a minimum of ten (10) feet of cable within the junction box. The wires shall be sealed to prevent the entry of moisture into the ends of the loop leads.
- e. If unable to complete the installation, and it is necessary to leave the lead-ins exposed, the installer shall seal the wires to prevent the entry of moisture.

Contractor shall protect the wires to ensure that the operational ability of the loop remains when final installation is complete.

- f. Loops shall be ohmed out prior to installation to ensure continuity.
 - g. All loops shall be located as shown on the plans or as directed by the Engineer or Engineer's designee.
 - h. Where loop lead-ins enter the junction box, each loop shall be identified as specified, on the plans.
 - i. Each loop shall have four (4) turns of wire per loop, with ends reaching the junction box. There shall be no splices under the pavement.
 - j. Unless otherwise noted on the plans, the standard loop size is to be six feet by six (6 x 6) feet.
2. Sawed in Loop Installation
- a. Sawed slots in the pavement shall be blown out with compressed air and shall be clean and free of loose grit and moisture when wires are placed and sealer is applied.
 - b. Slots shall be 1/16 in. to 1/8 in. wider than the outside diameter of the loop wire or tubing.
 - c. The slot depth shall provide a covering of not less than 3/4" in. above the uppermost detector wire tubing after the loop installation is completed.
 - d. With the approval of the engineer, loop detector wire installations in new asphalt may be sawed and embedded with sealant in a subsurface course with subsequent covering by the surface course.
 - e. The wire shall be laid in the slots so there are no kinks or curls and no straining or stretching of the insulation on the wire.
 - f. Loop wires or lead-ins shall be given extra protection at pavement joint locations. The extra protection shall consist of a 12 in. long piece of 3/4 in. flexible tubing that fits snugly around the wires. Allow slack in the wires to install the hose or tubing. A longitudinal cut or slot may be made along the bottom of this material for ease of placing wires within hose or tube.
3. Preformed Loop Installation
- a. All loops shall be secured in the base course material in such a manner as to remain in place during paving operations.

- b. All loops disturbed or damaged during paving operations shall be replaced with in-kind preformed, under pavement loops.
- c. Loops shall be buried in the gravel base with one to four inches of cover.

G. Poles

- 1. Poles shall be plumb when the installation is complete with anchor bolt nuts firmly tightened.
- 2. Field repair of damaged galvanizing shall be done in accordance with AASHTO M36.

END OF SECTION

SECTION 93

PAVEMENT MARKING AND PERMANENT SIGNAGE

93.1 DESCRIPTION

A. General

This work consists of furnishing and installing, or installing permanent pavement markings and permanent traffic signage. The specific combination of Contractor furnished and installed material or City furnished and Contractor installed material will be as called for in the Bidder's Proposal or as directed by the Engineer.

All traffic control remaining on the site following project acceptance shall become the property of the City. All existing traffic control devices shall remain the property of the City. All signs, signals, or delineators removed by the Contractor shall be delivered in the condition prior to removal to the City of Rapid City, Traffic Operations yard at 709 Steele Avenue , unless directed otherwise by the Engineer. All returned traffic control devices shall be delivered disassembled. A delivery list shall accompany all returned traffic control devices.

B. Related Work

Section 90 Traffic Control
Section 91 Traffic Control Devices
Section 92 Traffic Signals and Roadway Lighting

93.2 MATERIALS

A. General

All Traffic Control Devices shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD), South Dakota State Department of Transportation (SDDOT) design guidelines and specifications, City of Rapid City design requirements, and as directed by the Engineer.

B. Pavement Marking Tape

Permanent Pavement Marking Tape shall conform to SDDOT specification section 983 - Cold-Applied Thermoplastic Pavement Marking and Legends.

Pavement marking tape shall be 3M™ Type 380/381 ES WR grade for all longitudinal and diagonal lines. All transverse lines and pavement messages shall be 3M™ type 420. Other cold plastic tape material may be used, only if pre-approved by the Traffic Engineer and are equal to the types specified.

C. Pavement Marking Paint

Paint pavement markings and beads, when specified, shall meet or exceed current State of South Dakota specification for such materials.

D. Signage

All signs shall be fabricated using an aluminum backing having a thickness of 0.080 inches and meeting the other requirement contained in SDDOT specification section 982.2A.1-2.

High Intensity Reflective Sheeting (Type III or higher) will be required for use on all signs except street name signs, which shall be Diamond Grade™ VIP sheeting (Type IX).

All sign facing shall use a pressure sensitive adhesive to attach the sign face to backing.

All facing materials and inks used in sign fabrication shall have a minimum five-year manufacturer's warranty.

All sign posts shall be galvanized square perforated tube in accordance with South Dakota Department of Transportation Specification 632. and 982.2, C.1., Perforated Tube Posts. Sign posts shall have a 12 gauge wall thickness.

93.3 CONSTRUCTION REQUIREMENTS

A. General

The Contractor shall furnish, and/or install required pavement marking material, signs and delineators.

B. Permanent Pavement Marking

Permanent Pavement Marking Tape installation shall conform to SDDOT specification section 983 - Cold-Applied Thermoplastic Pavement Marking and Legends, permanent Pavement Marking Tape shall be applied in accordance with the manufacturer's recommendations. Permanent Pavement Marking Tape shall carry to the City all standard manufacturers' warranties.

Installation of painted pavement markings and beads, when specified, shall meet or exceed current State of South Dakota specification for such materials.

Permanent centerline marking and, on multi-lane sections, permanent lane lines, and stop bars at traffic signals shall be placed prior to opening to traffic newly paved or

roto-milled surfaces, asphalt surface treatments, seal, prime, and tack coats. Marking of edge lines are not required prior to opening to traffic.

Permanent markings shall be of the design, size and color specified on the plans or as directed by the Engineer.

Permanent Road Markers shall be applied in accordance with the manufacturer's recommendations. Location, color and number shall be as shown on the plans, or, as directed by the Engineer. Specific type used shall be, approved by the Engineer prior to use.

C. Removal of Pavement Markings

Traffic stripes and pavement markings not matching current traffic flows, or as designated by the Engineer, shall be completely removed and obliterated. Existing and temporary markings, which the Engineer determines to be no longer applicable shall be completely removed and obliterated at no expense to the City. Removal of **ALL** conflicting existing and temporary markings shall be completed prior to opening the road to traffic. Temporary markings shall be removed prior to the installation of replacement permanent pavement markings.

Pavement markings shall be removed by any method that does not damage the surface or texture of the pavement. Sand or other material deposited on the pavement as a result of removing markings shall be removed as work progresses. Accumulations of blast media or other material, which might interfere with drainage or might constitute a hazard to traffic, will not be permitted.

Covering the markings is not acceptable.

Where blast cleaning is used for the removal of pavement markings or for removal of objectionable material, and such removal operation is being performed within ten (10) feet of a lane occupied by the traveling public, the residue, including dust, shall be removed immediately after contact between the blast media and the surface being treated. Removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation or by other methods approved by the Engineer. Contractor shall take all necessary precautions to protect the traveling public during the removal operation.

Damage to the pavement or surfacing caused by pavement marking removal shall be repaired at the Contractor's expense by methods acceptable to the Engineer.

D. Installation of Pavement Markings

Permanent pavement marking installation shall occur in a manner and environment meeting all manufacturers' recommendations. Installation shall be done in such a manner so as to not void any applicable manufacturer's warranties.

Whenever a non-standard installation method is called for on the drawings, Detailed Specification will govern such installations.

When weather, time-of-year, or the Contractor's operation does not allow the installation of permanent pavement markings, the Contractor install temporary markings and remain responsible for the maintenance of temporary pavement markings until such time as the permanent pavement markings are installed.

E. Permanent Traffic Signage

Permanent traffic signage shall meet all requirements of the City, State of South Dakota Department of Transportation (SDDOT) specifications and those contained in the Manual on Uniform Traffic Control Devices.

All signs shall be mounted in a manner that satisfies break-away requirements as set forth by the FHWA and SDDOT. Break-away support hardware shall be of a type similar to that in use by the City at the time of sign installation.

Permanent traffic signs shall be installed where shown on the plans, or, as modified by the Engineer. A list of all traffic signs installed shall be furnished to the City.

All signs shall be sized to meet the "standard" sign size as defined in the Manual on Uniform Traffic Control Devices. Over sized signs will be identified in the plans.

Permanent traffic sign installation shall include the sign face, backing, post, stub, and all incidental hardware.

Sign post sleeves installed in pavement areas shall be installed within an approved casing.

All signs installed during the period of construction shall remain the full responsibility of the contractor until acceptance by the City. All permanent traffic signs shall be installed prior to allowing traffic onto the adjacent section of roadway.

93.4 METHOD OF MEASUREMENT

Measurement for permanent pavement markings shall be as follows:

All line markings (longitudinal or transverse) shall be measured to the nearest linear foot.

All messages will be measured on a per each message basis.

Measurement for permanent traffic signs shall be on a per sign basis. Signs having similar legends shall be considered to have similar prices as long as the size and color of the sign is the same.

93.5 BASIS OF PAYMENT

Payment will be for the actual quantities furnished and/or installed. It shall remain the option of the City to determine which combination of furnish/install is used for each item.

Payment for permanent pavement markings will be made at the contract unit price as per the basis of measurement and shall be considered as full compensation for costs incidental thereto. Payment will be made following acceptance by the City. Prior to acceptance the contractor shall supply to the City all necessary warranty certifications. Payment will be full compensation for installation.

Payment for permanent traffic signage will be made at the contract unit price for each sign. If payment is made for a manufactured/installed sign, or sign installation, all posts, mounting hardware and incidentals shall be included in the payment cost. Payment will be made following acceptance by the City. Payment will be full compensation.

END OF SECTION

SECTION 100

PORTLAND CEMENT

100.1 DESCRIPTION

A. General

Portland cement shall be used as called for herein.

B. Related Work

Section 40 Portland Cement Concrete Pavement
Section 55 Concrete Masonry
Section 56 Concrete for Incidental Construction (Class M)
Section 60 Concrete Curb And Gutter
Section 61 Concrete Sidewalk And Handicap Ramps
Section 62 Drop Inlets
Section 67 Fabric Formed Concrete Mat

100.2 MATERIALS (Not specified)

100.3 CONSTRUCTION REQUIREMENTS

Portland Cement shall conform to the requirements of AASHTO M 85 for the type specified. Type II cement shall not have more than 0.60 percent of Alkalies ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$).

Unless otherwise permitted by the Engineer, the product of only one mill of any one brand and type of Portland cement shall be used on the project.

100.4 METHOD OF MEASUREMENT & 100.5 BASIS OF PAYMENT

Portland cement shall be incidental to and shall be paid as a part of the individual bid item. There will be no separate measurement and payment for Portland cement.

END OF SECTION

SECTION 101

AIR-ENTRAINING ADMIXTURES

101.1 DESCRIPTION

A. General

Air-entraining admixtures shall be used as called for in the related specifications section herein for all concrete that will be exposed to repeated freeze and thaw cycles.

B. Related Work

Section 40	Portland Cement Concrete Pavement
Section 55	Concrete Masonry
Section 56	Concrete for Incidental Construction (Class M)
Section 60	Concrete Curb and Gutter
Section 61	Concrete Sidewalk and Handicap Ramps
Section 62	Drop Inlets
Section 67	Fabric Formed Concrete Mat
Section 124	Fabric Formed Concrete Mat Material
Section 200	Controlled Low Strength Material

101.2 MATERIALS (Not specified)

101.3 CONSTRUCTION REQUIREMENTS

Air-entraining admixtures for concrete shall conform to the requirements of AASHTO M 154, except as specified below:

Concrete having sufficient air-entraining admixture added to entrain five to seven percent air shall have compressive strength at the age of seven days of not less than 90% of the standard.

The standard for concrete that will not be exposed to repeated freeze and thaw cycles shall consist of a concrete of equal cement content, equal consistency, and of the same aggregates in adjusted proportions, but without the addition of an air-entraining admixture.

101.4 METHOD OF MEASUREMENT & 101.5 BASIS OF PAYMENT

Air-entraining admixtures for concrete shall be as called for herein and shall be included in the individual bid item. There will be no separate measurement and payment for air-entraining admixtures.

END OF SECTION

SECTION 102

CHEMICAL ADMIXTURES FOR CONCRETE

102.1 DESCRIPTION

A. General

Chemical admixtures for concrete shall be used as called for herein.

B. Related Work

Section 40 Portland Cement Concrete Pavement
Section 55 Concrete Masonry
Section 56 Concrete for Incidental Construction (Class M)
Section 60 Concrete Curb and Gutter
Section 61 Concrete Sidewalk and Handicap Ramps
Section 62 Drop Inlets
Section 67 Fabric Formed Concrete Mat

102.2 MATERIALS (Not specified)

102.3 CONSTRUCTION REQUIREMENTS

Chemical admixtures for concrete shall conform to the requirements of AASHTO M 194.

102.4 METHOD OF MEASUREMENT &

102.5 BASIS OF PAYMENT

Chemical admixtures for concrete shall be as called for and shall be measured and paid for in accordance with the appropriate concrete construction sections of these Specifications. There will be no separate measurement and payment for chemical admixtures for Concrete.

END OF SECTION

SECTION 104

WATER FOR USE IN PORTLAND CEMENT CONCRETE

104.1 GENERAL REQUIREMENTS

A. General

Water for use in Portland Cement Concrete, mortar and cement stabilization or similar uses shall be as described herein.

B. Related Work

- Section 40 Portland Cement Concrete Pavement
- Section 55 Concrete Masonry
- Section 56 Concrete for Incidental Construction (Class M)
- Section 60 Concrete Curb and Gutter
- Section 61 Concrete Sidewalk and Handicap Ramps
- Section 62 Drop Inlets
- Section 67 Fabric Formed Concrete Mat

104.2 SPECIFIC REQUIREMENTS

A. Requirements

Water used in Portland Cement Concrete and cement stabilization shall be clean and free of oil, salt, acid, alkali, sugar, vegetation, effluent from a sewage disposal plant and other substances detrimental to the finished product.

Water containing suspended matter shall be checked for turbidity. The suspended solids shall not exceed 2000 parts per million.

Water shall be tested for pH and dissolved solids. The pH shall be no less than 6.0 or more than 8.6. Maximum dissolved solids shall be no more than 2500 parts per million.

Should either the suspended matter, pH or dissolved solids tests fail to meet the requirements, the Engineer may request further tests be made according to Section 3.4 of AASHTO T 26.

B. Testing

- Turbidity.....SD414
- Dissolved Solids..... SD415
- pH.....Manufacturer Instructions w/Meter

**104.3 METHOD OF MEASUREMENT &
 104.4 BASIS OF PAYMENT**

Water used in Portland Cement Concrete and cement stabilization shall be incidental to the various bid items. There will be no separate payment for water used in Portland Cement Concrete and cement stabilization.

END OF SECTION

SECTION 105

FINE AGGREGATE FOR USE IN PORTLAND CEMENT CONCRETE

105.1 GENERAL REQUIREMENTS

A. General

Fine aggregate shall consist of natural sand, or, subject to approval, other inert materials with similar characteristics, or combinations thereof, having hard, strong, durable particles.

Fine aggregate from different sources shall not be mixed or stored in the same pile nor used alternately in the same class of construction or mix, without permission from the Engineer.

B. Related Work

Section 40 Portland Cement Concrete Pavement
 Section 55 Concrete Masonry
 Section 56 Concrete for Incidental Construction (Class M)
 Section 60 Concrete Curb and Gutter
 Section 61 Concrete Sidewalk and Handicapped Ramps
 Section 62 Drop Inlets
 Section 67 Fabric Formed Concrete Mat
 Section 107 Course Aggregate for use in Portland Cement Concrete

105.2 SPECIFIC REQUIREMENTS

A. Deleterious Substances

The amount of deleterious substances shall not exceed the following limits by dry weight:

Clay lumps	0.50%
Coal and lignite	0.25%
Shale and other materials having a specific gravity less than 1.95.....	1.00%
Other deleterious substances (such as alkali, mica, coated grains, soft and flaky particles	1.00%

The maximum amount of all deleterious substances listed above shall not exceed two percent (2.00%) by dry weight.

B. Soundness

When the fine aggregate is subjected to five alternations of the sodium sulfate soundness test, the weighted loss shall not exceed ten percent by weight.

When subject to five alternations of the sodium sulfate soundness test, the weighted loss of Class M concrete fine aggregate shall not exceed 12 percent by weight.

A satisfactory soundness record for deposits from which material has been used in concrete for five years or more may be considered as a substitute for performing the sodium sulfate soundness test.

C. Organic Impurities

Fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the standard shall be rejected unless they pass the mortar strength test specified in Paragraph D.

Should the aggregate show a darker color than samples originally approved for the work, it shall not be used until tests have been made to determine whether the increased color is indicative of an injurious amount of deleterious substances.

D. Mortar-Making Properties

When subjected to the test for mortar-making properties, the fine aggregate shall develop a compressive strength at the age of three days when using Type III cement or at seven days when using Types I or II cement, of not less than 90 percent of the strength developed by a mortar prepared in the same manner with the same cement and graded Ottawa sand having a fineness modulus of 2.40 ± 0.10 .

E. Grading

Fine aggregate shall be well graded from coarse to fine and shall conform to the following requirements:

Passing 3/4 inch sieve.....	100%
Passing No. 4 sieve.....	95-100%
Passing No.16 sieve.....	45-85%
Passing No. 50 sieve.....	10-30%
Passing No.100 sieve.....	2-10%

Class M concrete fine aggregate shall conform to the requirements, except the percent passing No. 100 sieve shall be 0-10%.

The percentage of material passing the No. 200 sieve shall be such that the composite mixture of fine and coarse aggregate will conform to the provisions of Section 107.

Fine aggregate failing to pass the minimum requirement for material passing the No. 50 or the No. 100 sieve may be used provided a satisfactory inorganic fine material is added during production to correct for the deficiency in gradation.

F. Uniformity of Grading

The gradation requirements given in Section 105.2.E. represent the extreme limits, which shall determine suitability for the use from all sources of supply. The gradation from any source shall be reasonably uniform and shall not exceed the extreme percentages of gradation specified above. For determining the degree of uniformity, a fineness modulus shall be made upon representative samples from source proposed for use. Fine aggregate from any source having a variation in fineness modulus greater than plus or minus two-tenths (0.2) from a representative sample may be rejected.

The uniformity of grading requirements does not apply to fine aggregate for Class M concrete.

G. Sampling and Testing

Sampling.....	SD 201
Gradation.....	SD 202
Shale	SD 208
Soundness.....	AASHTO T 104
Organic Impurities	AASHTO T 21
Clay Lumps.....	AASHTO T 112
Uniformity of Grading (Fineness Modulus)	AASHTO M 6

105.3 METHOD OF MEASUREMENT &

105.4 BASIS OF PAYMENT

Fine aggregate for use in Portland Cement Concrete or similar uses will not be measured or paid separately, but shall be incidental to the various bid items.

END OF SECTION

SECTION 106

MASONRY MORTAR SAND AND EPOXY RESIN MORTAR SAND

106.1 MASONRY MORTAR SAND REQUIREMENTS

A. General

Aggregate for use in masonry mortar shall consist of natural sand or manufactured sand. Manufactured sand is the product obtained by crushing stone, gravel, or air-cooled iron blast-furnace slag specially processed to assure suitable particle shape as well as gradation.

B. Gradation

Percent Passing

	Natural Sand	Manufactured Sand
No. 4	100	100
No. 8	95-100	95-100
No. 16	70-100	70-100
No. 30	40- 75	40- 75
No. 50	10- 35	20- 40
No. 100	2- 15	10- 25
No. 200	---	0- 10

Not more than 50 percent may be retained between any two consecutive sieves listed.

Not more than 25 percent may be retained between the No. 50 and No. 100 sieves.

C. Deleterious Substances

The amount of deleterious substances shall not exceed the following limits by dry weight:

1. Clay lumps and friable particles.....1.0%
2. Lightweight particles having a specific gravity
of less than 1.95.....0.5%

D. Soundness

When the fine aggregate is subject to five alternations of the sodium sulfate soundness test, the weighted loss shall not exceed 10 percent by weight.

A satisfactory soundness record for deposits from which material has been used for 5 years or more may be considered as a substitute for performing the sodium sulfate soundness test.

E. Organic Impurities

The aggregate shall be free of injurious amounts of organic impurities. Except, as herein provided, aggregates subjected to the test for organic impurities and producing a color darker than the standard shall be rejected.

Aggregate failing in the test may be used if the discoloration is due principally to the presence of small quantities of coal ignites or similar discrete particles.

Aggregate failing in the test may be used if, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 and 28 days calculated in accordance with Section 10 of AASHTO T71 Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar is not less than 95 percent.

106.2 EPOXY RESIN MORTAR SAND REQUIREMENTS

A. General

The aggregate shall be silica sand.

B. Gradation

Sieve Size	Percent Passing
No. 8	100
No. 50	15 to 40
No. 100	0 to 10
No. 200	0 to 0.5

**106.3 METHOD OF MEASUREMENT &
106.4 BASIS OF PAYMENT**

Sand for mortar shall be incidental to the various bid items. There will be no separate measurement and payment for sand used for mortar.

END OF SECTION

SECTION 107

COARSE AGGREGATE FOR USE IN PORTLAND CEMENT CONCRETE

107.1 GENERAL REQUIREMENTS

A. Coarse Aggregate for Concrete Pavement:

The coarse aggregate shall consist of crushed limestone rock or other crushed quarry rock from a source that is approved by SDDOT and meets City of Rapid City and SDDOT specifications for coarse aggregate for use in Portland Cement Concrete.

B. Coarse Aggregate for Class A and M Concrete:

The coarse aggregate shall consist of crushed limestone rock or other crushed quarry rock from a source that is approved by SDDOT and meets City of Rapid City and SDDOT specifications for coarse aggregate for use in Portland Cement Concrete.

C. Coarse Aggregate for Bridge Deck Resurfacing:

The coarse aggregate shall be produced from crushed quarry stone from sources approved by the Engineer.

D. Related Work:

- Section 40 - Portland Cement Concrete Pavement
- Section 55 - Concrete Masonry
- Section 56 - Concrete for Incidental Construction (Class M)
- Section 60 - Concrete Curb and Gutter
- Section 61 - Concrete Sidewalk and Handicap Ramps
- Section 62 - Drop Inlets
- Section 67 - Fabric Formed Concrete Mat

107.2 SPECIFIC REQUIREMENTS

A. Deleterious Substances:

The amount of deleterious substances shall not exceed the following limits by dry weight:

Clay lumps..... 0.25%

Coal and lignite.....	0.25%
Shale and other materials having a specific gravity less than 1.95%..	1.00%
Soft fragments.....	2.00%
Other deleterious substances (such as alkali, mica, coated grains, flaky particles, and chocolate rock).....	2.00%

The maximum amount of deleterious substances listed above shall not exceed two percent (2.00%) by dry weight.

The deleterious substances in the coarse aggregate for Class M concrete shall not exceed the following limits:

Clay lumps.....	0.50%
Coal Lignite.....	0.25%
Shale and other material of less than 1.95 specific gravity.....	1.00%
Soft fragments.....	2.00%
Other deleterious materials (such as alkali, mica, coated grains, flaky particles and chocolate rock).....	3.00%

The maximum amount of deleterious material shall not exceed three percent (3.00%) by dry weight.

B. Percentage of Wear:

The percentage of wear, Los Angeles abrasion test, shall not be more than forty percent (40%) by weight.

C. Soundness:

When the coarse aggregate is subjected to five (5) alternations of the sodium sulfate soundness test, the weighted loss shall not exceed ten percent (10%) by weight.

When Class M coarse aggregate is subjected to five (5) alternations of Sodium Soundness test, the weighted loss shall not exceed twelve percent (12%) by weight.

A satisfactory soundness record for deposits from which material has been used in concrete for five (5) years or more, may be considered as a substitute for performing the sodium sulfate soundness test.

D. Gradation:

Each size of coarse aggregate shall conform to the gradation requirements specified in the following table:

PERCENTAGE BY DRY WEIGHT PASSING SIEVE

Size	Nominal Size	1ø in.	1 in.	¾ in.	½ in.	3/8 in.	#4	#8
------	--------------	--------	-------	-------	-------	---------	----	----

No. Sq. Openings

1	1 inch-No. 8	100	95-100		25-60		0-10	0-5*
3	3/4 inch-No. 8			100	97-100	40-90	5-20	0-5*
5	1/2 inch-No. 8			100	90-100	40-70	0-20	0-5*

*The combined mixture of fine and coarse aggregate shall be such that not more than 1.5 percent passes the No. 200 sieve. This limit shall not be more than 2.5% for Class M Concrete.

E. Sampling and Testing:

Sampling	SD 201
Gradation.....	SD 202
Clay Lumps	AASHTO T 112
Lightweight Particles	SD 214
Soft Fragments.....	SD 218
Chocolate Rock	SD 216
LA Abrasion.....	AASHTO T 96
Soundness Test	SD 220
Material Finer than No. 200 Sieve.....	SD 206

107.3 METHOD OF MEASUREMENT &

107.4 BASIS OF PAYMENT

Coarse aggregate for use in Portland Cement Concrete and similar uses will be considered incidental to the various bid items. There will be no separate measurement and payment for coarse aggregate used in Portland Cement Concrete and similar uses.

END OF SECTION

SECTION 108

CONCRETE CURING MATERIALS

108.1 REQUIREMENTS

Curing materials shall conform to the following requirements as specified:

- A. Burlap Cloth made from jute or kenaf meeting the requirements of AASHTO M 182, Class 3. (It will be permissible to use Class 1 or 2, provided it is placed in double layers.)
- B. Liquid Membrane-Forming Compounds for curing concrete meeting the requirements of AASHTO M 148, Type 2.
- C. Polyethylene Sheeting:

White polyethylene sheeting shall be durable to withstand the intended job use without puncturing or tearing. During cool weather, the Engineer may permit the use of Black polyethylene sheeting in lieu of white polyethylene sheeting.

- D. Linseed Oil Base Emulsion Compound for Curing Concrete:

- 1. Composition:

The compound shall conform to the requirements of AASHTO M148, Type 2, except as modified by the following:

- a. The compound shall be a water-emulsified linseed oil emulsion of $50 \pm 4\%$ oil phase / $50 \pm 4\%$ water phase composition. (Linseed oil phase / water phase proportions shall be formulated exclusive of added pigment.) Linseed oil emulsion shall be tested in accordance with SD 509.
- b. Linseed oil used in the emulsion formulation shall consist of a blend of 80 percent boiled linseed oil and 20 percent Z-8 viscosity linseed oil meeting the requirements of ASTM D 260.
- c. The compound shall be spray-able above 50 degrees F.

- 2. Storage:

The compound shall be stored at temperatures above 35 degrees F. Compound stored for a period in excess of one (1) construction season will require re-sampling and testing for compliance prior to use.

**108.2 METHOD OF MEASUREMENT &
108.3 BASIS OF PAYMENT**

Concrete curing materials shall be incidental to the various concrete construction bid items. There will be no separate measurement and payment for concrete curing materials.

END OF SECTION

SECTION 109

RIPRAP AND SLOPE MATERIALS

109.1 REQUIREMENTS

A. Riprap:

Stone for riprap shall be hard, angular, and durable and shall have a minimum weight of 155 pounds per cubic foot. Stone may either be quarried ledge rock or field stone. Stone shall be free from overburden, spoil, shale, and organic material and shall meet the following gradation requirements.

	Size of Stone (lbs.)	% of Total Wt.
Class I	150 to 100	15 to 25
	100 to 50	15 to 45
	50 to 5	15 to 55
	5 to 0	0 to 10
Class II	500 to 300	15 to 25
	300 to 150	15 to 45
	150 to 15	15 to 55
	15 to 0	0 to 15
Class III	1000 to 600	15 to 25
	600 to 300	15 to 45
	300 to 30	15 to 55
	30 to 0	0 to 15
Class IV	1400 to 1000	15 to 25
	1000 to 500	15 to 55
	500 to 50	15 to 45
	50 to 0	0 to 15
Class V	2000 to 1400	15 to 25
	1400 to 700	15 to 45
	700 to 70	15 to 55
	70 to 0	0 to 20

Each load of riprap shall be well graded from the smallest to the maximum size specified. No more than five percent (5%) by weight shall pass a one-half (1/2) inch square opening sieve.

B. Filter Material:

Filter material shall consist of clean, hard, durable, open graded sand, gravel, or rock, crushed or uncrushed, meeting the following gradation requirements by dry weight:

Passing a 3 inch sieve.....	100%
Passing a 3/4 inch sieve.....	70 to 95%
Passing a No. 4 sieve.....	40 to 75%
Passing a No. 200 sieve.....	0 to 8%

The P.I. of the filter material shall not exceed six (6).

The material shall be obtained from approved sources, which contain no organic matter or soft friable particles. Pit run local material will be acceptable if the specifications are met.

C. Testing:

Plasticity Index.....	SD 207
Specific Gravity.....	SD 210

**109.2 METHOD OF MEASUREMENT &
109.3 BASIS OF PAYMENT**

Measurement and payment shall be in accordance with Sections 65 and 66 of these specifications.

END OF SECTION

SECTION 111

CRUSHED AGGREGATE FOR MAINTENANCE (TRAVEL GRAVEL)

111.1 GENERAL REQUIREMENTS

A. General

This work shall consist of furnishing and placing crushed rock gravel on a prepared roadbed for the purposes of maintenance of vehicular or pedestrian traffic.

B. Related Work Items

Section 12	Roadway and Drainage Excavation
Section 14	Embankment
Section 20	Granular Materials
Section 117	Aggregates for Granular Bases and Surfacing

111.2 SPECIFIC REQUIREMENTS

A. General

The crushed gravel shall consist of hard, clean, heavy, durable fragments, free of dirt, vegetable and foreign materials.

B. Gradation

The crushed gravel, when mixed with filler, sand, crushed rock, or crushed stone, shall meet the following gradation and quality requirements by dry weight:

Percent passing a 3/4 inch sieve.....	100
Percent passing a 5/8 inch sieve.....	80-100
Percent passing a No. 4 sieve.....	40-80
Percent passing a No. 10 sieve.....	20-50
Percent passing a No. 40 sieve.....	10-30
Percent passing a No. 200 sieve.....	3-20

A tolerance of three percent in the amount passing the maximum size screen will be permitted, providing all material passes a screen having one-fourth inch larger openings.

C. Los Angeles Abrasion

Abrasion loss shall not exceed 40 percent.

D. Plasticity

Plasticity Index shall not exceed 15.

E. Sampling and Testing

Sampling	SD 201
Gradation	SD 202
L.L. & P.I.	SD 207
Los Angeles Abrasion	AASHTO T96

111.3 CONSTRUCTION REQUIREMENTS

Unless otherwise specified, granular materials shall be placed in accordance with Section 20 - Granular Materials.

111.4 METHOD OF MEASUREMENT

Granular materials shall be measured in accordance with Section 20 - Granular Materials.

111.5 BASIS OF PAYMENT

Unless otherwise specified, the accepted quantities of granular material will be paid in accordance with Section 20 - Granular Materials.

END OF SECTION

SECTION 112

SELECT GRANULAR BACKFILL

112.1 DESCRIPTION

A. General:

This work shall consist of furnishing select granular backfill materials.

B. Related Work:

Section 8	Water Piping Systems
Section 11	Utility Excavation and Backfill
Section 12	Roadway and Drainage Excavation
Section 20	Granular Materials
Section 64	Under-drains
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 109	Riprap and Slope Materials

112.2 MATERIALS

A. General:

This material shall be free from dirt, vegetable matter, cinder, ashes, refuse, organic matter or other unsuitable foreign substance. Frozen material may not be used.

B. Utility Trench Backfill:

Type 1, Type 2 or Type 3 material shall be a crushed limestone rock having a minimum of two fractured faces and meet the following gradation requirements by dry weight:

1. Type 1 - Bedding Material

Passing 1 inch sieve.....	100%
Passing 3/4 inch sieve.....	90-100%
Passing 3/8 inch sieve.....	20-55%
Passing #4 sieve	0-10%
Passing #8 sieve	0-8%

2. Type 2 - Foundation Material

Passing a 3 inch sieve.....	100%
Passing a 3/4 inch sieve.....	50-70%
Passing a #4 sieve	20-40%
Passing a #200 sieve	0-8%

3. Type 3 - Foundation Material

- Passing a 3 inch sieve..... 100%
- Passing a 1 inch sieve.....0-15%
- Passing a #4 sieve0-8%

C. Roadway Backfill and Utility Trench Special Foundation Material:

Roadway foundation backfill and utility trench special foundation backfill for stabilization of sub grade shall be a crushed rock with a minimum of two fractured faces and shall meet the following gradations:

1. Type 4 - Foundation Material

- Passing the 8 inch sieve..... 100%
- Passing the 6 inch sieve.....65-85%
- Passing the 3 inch sieve.....0-20%
- Passing the #200 sieve0-5%

2. Stabilization Rock

Shall be further classified as follows:

Class I	Stabilization Rock
Class II	Stabilization Rock
Class III	Stabilization Rock
Class IV	Stabilization Rock
Class V	Stabilization Rock

Each class of stabilization rock above shall meet the same corresponding Class I-V gradation requirements as riprap in Section 109. Stabilization rock shall be a crushed rock with a minimum of two fractured faces.

D. Under drain Pipe Trench Backfill Material:

1. Rock used as backfill around under-drains shall be clean, washed and sound materials free of excess fines and deleterious materials as specified herein.
2. Rock used as backfill for under-drains or edge-drains shall be Type 1 Bedding Material. Rounded river rock meeting the Type 1 Bedding Material gradation shall be acceptable for installations located behind the curb. Installations located under or in front of the curb and gutter shall be a crushed rock with a minimum of two fractured faces.

E. Los Angeles Abrasion:

Abrasion loss shall not exceed 40 percent.

F. Sampling and Testing:

Sampling	SD 201
Gradation.....	SD 202
Fractured Faces	SD 211
Los Angeles Abrasion	AASHTO T 96

112.3 METHOD OF MEASUREMENT

Measurement for Select Granular Backfill materials, except as further defined below, shall be to the nearest 0.1 ton based on the total weight of the material furnished and installed as determined from valid weigh tickets.

Type 1. Bedding material for water and sewer pipe installations as described in sections 8, 9, and 11 shall be considered as incidental to the pipe being installed. The Contractor and Engineer shall, on a daily basis, quantify the amount of type 1 bedding material installed along with the corresponding quantity of water and/or sewer pipe. The Contractor shall submit, daily to the Engineer, weigh tickets for type 1 bedding material. The weigh tickets shall clearly state "Type 1 bedding material, incidental." All stockpiled Type 1 bedding material used for water and sewer pipe installation shall be clearly identified on the project.

Type 1 bedding material used as foundation material or for uses other than bedding for water and sewer pipe shall be measured in accordance with the provisions above and shall be measured to the nearest 0.1 ton.

Under-drain Pipe Trench Backfill material shall be measured in accordance with Specification Section 64.4.

112.4 BASIS OF PAYMENT

Payment for Select Granular Backfill materials, except as further defined below, shall be made under the appropriate bid item for the material furnished and installed. Payment for select granular backfill materials shall include all associated costs of excavation and disposal of excavated materials, unless otherwise called for in the drawings or detailed specifications.

Type 1 bedding material for water and sewer piping installations as described in specification sections 8, 9, and 11 shall be considered incidental to the pipe being installed. All associated costs of excavation and disposal of excavated material shall be considered incidental to the pipe installation, unless called for otherwise in the drawings and detailed specifications.

Type 1 bedding material used as foundation material or for a purpose other than pipe bedding shall be paid for in accordance with the provisions above and under the appropriate bid item.

Payment for Under-drain Pipe Trench Backfill material shall be in accordance with Specification Section 64.5.

END OF SECTION

SECTION 113

PREFORMED EXPANSION JOINT FILLER FOR CONCRETE

113.1 REQUIREMENTS

Preformed expansion joint filler for concrete shall conform to the requirements of AASHTO M 213.

113.2 METHOD OF MEASUREMENT & 113.3 BASIS OF PAYMENT

Preformed expansion joint filler shall be incidental to the various concrete construction bid items. There will be no separate measurement and payment for preformed expansion joint filler.

END OF SECTION

SECTION 114

CONCRETE JOINT SEALER

114.1 REQUIREMENTS

A. Hot Poured Elastic Joint Sealer:

The sealant shall conform to the requirements of ASTM D 3405. Test methods shall conform to ASTM D 3407 except that the fine aggregate used in preparing concrete test blocks shall conform to Section 105 of these Specifications. The manufacturer shall furnish a Certificate of Compliance for the material.

B. Low Modulus Silicone Sealant:

The sealant shall be furnished in a one-part silicone formulation. The sealant must be on the list of approved products maintained by the City and must meet the following requirements:

TEST	LIMIT	TEST METHOD
Tack Free Time	20 - 75 minutes	MIL S 8802
Specific Gravity	1.010-1.515	ASTM D 792, Method A
Durometer Hardness Type A: (Cured 7 days at 77°F ±3° and 45% to 55% R.H.)	10-25 (0°F)	ASTM D 2240
Tensile Stress: (at 150% elongation, 7- day cure at 77°F ±3° & 45% - 55% R.H.)	45 psi maximum	ASTM D 412 (Die C)
Elongation: (7-day cure at 77°F ± 3° & 45% - 55% R.H.)	1000% minimum	ASTM D 412 (Die C)
Shelf Life	6 mo. minimum from date of manufacture	

Ozone & Ultraviolet Resistance	No chalking, cracking or bond loss after 5000 hours	
Movement capability & Adhesion (7-day cure in air 77°F ± 3°)	No adhesive or cohesive failure; all 3 specimens must exceed 500% extension at 0°F	*
Bond to Concrete Mortar Concrete briquette (air cured 7 days at 77°F ±3°)	50 psi minimum (0°F)	AASHTO T 132**

Backer rod shall be a non-moisture-absorbing, resilient material approximately 25% larger in diameter than the width of the joint to be sealed. The rod shall be compatible with the sealant and no bond or reaction shall occur between the rod and the sealant.

* Prepare the specimens using 1 in x 2 in x 3 in concrete blocks in accordance with ASTM D 5329 except that the fine aggregate shall conform to Section 105. A sawed face shall be used for bond surface. Seal two (2) inches of block leaving one-half (1/2) inch on each end of specimen unsealed. The depth of sealant shall be three-eighths (3/8) inch and the width one-half (1/2) inch. Subject the sealant to movement at a rate of two (2) inches per minute until failure.

** Briquettes molded in accordance with AASHTO T 132 sawed in half and bonded with approximately ten (10) mils of sealant and tested using clips meeting AASHTO T 132. Briquettes shall be dried to constant weight in oven 100°C. ±5°. They shall be tested in tension at a loading rate of .3 inch/minute.

114.2 METHOD OF MEASUREMENT & 114.3 BASIS OF PAYMENT

Concrete joint sealer shall be incidental to various concrete construction bid items. There will be no separate measurement and payment for concrete joint sealer.

END OF SECTION

SECTION 115

AGGREGATES FOR ASPHALT CONCRETE

115.1 GENERAL REQUIREMENTS

The physical characteristics and quality of aggregates for asphalt concrete shall conform to the specifications for the particular asphalt material required by the contract.

The aggregate shall not contain clay balls or organic debris, and the particles shall be free from coating with clay or dust, which prevents thorough coating with asphalt.

115.2 SPECIFIC REQUIREMENTS

A. Mineral aggregate for all classes of asphalt concrete shall conform to the requirements shown in the following table and the applicable footnotes.

Requirement	<u>CLASS E</u>		<u>CLASS G</u>		<u>CLASS S</u>
	<u>Type 1</u>	<u>Type 2</u>	<u>Type 1</u>	<u>Type 2</u>	
	Crushed		Crushed		Crushed
Processing Required	Crushed		Crushed		Crushed
Passing ¾ inch Sieve	100		100		
Passing ½ inch Sieve	75 – 95	100	75 – 95	100	100
Passing 3/8 inch Sieve					80 – 100
Passing #4 Sieve	45 - 75	60 – 80	45 – 75	60 – 80	24 – 45
Passing #8 Sieve	30 – 55	40 – 60	30 – 55	40 – 60	10 – 22
Passing #16 Sieve	20 – 45	26 – 50	20 – 45	25 – 50	
Passing #40 Sieve	10 – 30	15 – 35	10 – 30	15 – 35	
Passing #200 Sieve	3 – 7	4 – 8	3 – 7	4 – 8	2 – 5
Soundness Loss, Max.	15		12		12
Liquid Limit, Max.	25		25		25
Plasticity Index, Max.	non-plastic		non-plastic		non-plastic
L.A. Abra. Loss, Max.	40%		35%		40%
Asphalt Coating, Min.	95%		95%		95%
Foot Notes	1, 2, 4, 5		1, 2, 4, 5		1, 2, 3, 5

1. A tolerance of three percent (3%) in the amount passing the maximum size screen will be permitted, providing all material passes a screen having a one-fourth (1/4) inch larger opening.

2. The aggregate retained on the No. 4 sieve shall contain at least thirty percent (30%) by dry weight of crushed pieces having two (2) or more faces produced by crushing.
3. The aggregate retained on the No. 4 sieve shall contain at least 90 percent (90%) by dry weight of crushed pieces having 2 or more faces produced by crushing.
4. The aggregate retained on the No. 4 sieve shall contain at least 50 percent (50%) by dry weight of crushed pieces having 2 or more faces produced by crushing.
5. The following requirements shall apply:

Sodium Sulfate	+ #4 sieve - 12% max.
	- #4 sieve - 12% max.

Shale Content	+ #4 sieve - 2% max.
	- #4 sieve - 2% max.

B. Classes E and G

1. Filler shall consist of fine, inert silt or stone dust, which is essentially free from lumps. The material shall be so fine that, when pulverized for testing, ninety percent (90%) by dry weight will pass a No. 40 sieve, and at least sixty percent (60%) by dry weight will pass a No. 200 sieve. The linear shrinkage shall not exceed four percent (4%), and the plasticity index shall not exceed six (6). The material shall be of such nature that not more than twenty-five percent (25%) by volume will separate from asphalt in the presence of water.

During production, the filler shall be screened over a screen of a size corresponding to the maximum size of the mineral aggregate. A larger size screen may be permitted or a smaller size required, if necessary, to facilitate production or to remove objectionable material. Lumps shall be pulverized prior to blending if required by the Engineer.

2. Crushed rock shall consist of hard, durable fragments of particles of rock, free of stripping, dirt, vegetable matter, and foreign substance.
3. Sand shall consist of sandy soil or crushed stone screenings. The sand shall be uniform in composition. Seams, layers, or pockets of soil encountered not meeting sand requirements shall be wasted. During production, the sand shall be screened over a screen of a size corresponding to the maximum size of the mineral aggregate. A larger size screen may be permitted or a smaller size required, if necessary, to facilitate production or to remove objectionable material.

The sand shall be pulverized at the pit prior to loading and shall meet the following requirements by dry weight:

Passing a No. 4 sieve.....	80-100%
Passing a No. 8 sieve.....	50-100%
Passing a No. 40 sieve.....	40-100%
Passing a No. 200 sieve.....	0- 60%
Plasticity Index, Max.....	6

4. Mineral filler shall consist of finely ground particles of stone, fly-ash, lime, or Portland Cement. It shall be thoroughly dry and free from lumps. It shall meet the following gradation requirements by dry weight when tested in accordance with AASHTO T 37.

Passing a No. 4 sieve.....	100%
Passing a No. 40 sieve.....	90-100%
Passing a No. 80 sieve.....	85-100%
Passing a No. 200 sieve.....	65-100%

115.3 SAMPLING AND TESTING

Sampling.....	SD 201
Gradation.....	SD 202
Liquid Limit and Plasticity Index.....	SD 207
Moisture sensitivity.....	SD 309
L.A. Abrasion Test.....	AASHTO T 96
Linear Shrinkage (Filler).....	SD 303
Soundness Test (Sodium Sulfate Solution - Five Alternations).....	SD 220
W.A.P. Test (Filler).....	SD 304
Crushed Particle Test.....	SD 211

115.4 METHOD OF MEASUREMENT &

115.5 BASIS OF PAYMENT

Aggregates for asphalt concrete will be incidental to the various asphalt concrete bid items. There will be no separate measurement and payment for aggregates for asphalt concrete.

END OF SECTION

SECTION 116

AGGREGATES FOR ASPHALT SURFACE TREATMENTS

116.1 REQUIREMENTS

A. General

The cover aggregate for asphalt surface treatments shall be sand, crushed rock or crushed gravel, which is free of dirt, vegetable and other foreign material. The physical characteristics and quality of the materials shall conform to the specifications for the particular material required by the contract.

B. Related Work

Section 37 Asphalt Surface Treatments

Section 38 Cold Mix Asphalt Concrete

116.2 SPECIFIC REQUIREMENTS

Cover aggregates of the various types shall conform to the following table:

REQUIREMENT Processing Required	TYPE 1		TYPE 2		TYPE 3
	A Crushed	B Crushed	A Crushed	B Crushed	Crushed
Passing 5/8 inch Sieve					100
Passing 1/2 inch Sieve	100			100	
Passing 3/8 inch Sieve	90-100	100	100	30-90	
Passing 1/4 inch Sieve	0-70				
Passing #4 Sieve	0-15	10 – 90	0 – 70	0 – 50	10 – 75
Passing #8 Sieve	0-5	0-30	0 – 28	0 – 20	0 – 62
Passing #40 Sieve		0 - 4	0 - 4	0 - 5	0 - 35
Passing #200 Sieve	0 - 1	0 - 3	0 - 3	0 - 3	0 - 18
Plasticity Index, max.	Non-plastic	3	3	3	3
L.A. Abra. Loss, max.	40%		40%	40%	40%
<u>Soundness Loss, max.</u>	<u>12</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>
Flakiness index (Max.)	30%				
Foot Notes	1	2	1,2	1,2	2

1. At least 50 percent of material retained on the No. 4 (4.75 mm) sieve shall have two or more fractured faces produced by crushing.
2. The plasticity index may be waived if not more than 4.0% of the material passes the No.40 (425um) sieve.

116.3 SAMPLING AND TESTING

Sampling	SD 201
Gradation	SD 202
Plasticity Index	SD 207
L.A. Abrasion Test.....	AASHTO T 96
Soundness Test (Sodium Sulfate Solution, Five Alternations)	AASHTO T 104
Crushed Particle Test.....	SD 211

**116.4 METHOD OF MEASUREMENT &
116.5 BASIS OF PAYMENT**

Measurement and payment for various cover aggregates for asphalt surface treatments shall be in accordance with Sections 37 & 38.

END OF SECTION

SECTION 117

AGGREGATES FOR GRANULAR BASES AND SURFACING

117.1 REQUIREMENTS

A. General

The aggregate for granular bases and surfacing shall consist of sound, durable particles of gravel and sand, with which may be included limited amounts of fine soil particles. The physical characteristics and quality of the materials shall conform to the specifications for the particular material required by the contract.

B. Related Work

Section 20 Granular Materials

117.2 SPECIFIC REQUIREMENTS

Aggregates for granular bases and surfacing shall be crushed limestone and shall conform to the requirements of Table 1.

TABLE 1

REQUIREMENTS	SUBBASE	GRAVEL CUSHION	¾" AGGREGATE BASE COURSE	1" AGGREGATE BASE COURSE	GRAVEL SURFACING
Processing Requirement.	Crushed	Crushed	Crushed	Crushed	Crushed
Passing 2 in Sieve	100%	100%	100%	100%	100%
Passing 1 in Sieve	70 – 100%	100%	100%	100%	100%
Passing ¾ in Sieve		100%	80 – 100%	80 – 95%	100%
Passing ½ in Sieve			68 – 90%	68 – 90%	
Passing #4 Sieve	30 – 70%	46 – 70%	42 – 70%	42 – 70%	50 – 78%
Passing #8 Sieve	22 – 62%	29 – 53%	29 – 53%	29 – 53%	37 – 67%
Passing #40 Sieve	10 – 35%	10 – 28%	10 – 28%	10 – 28%	13 – 35%
Passing #200 Sieve (1)	0 – 15%	3 – 12%	3 – 12%	3 – 12%	4 – 15%
Liquid Limit, Max.		25%	25%	25%	
Plasticity Index	0 – 6%	0 – 3%	0 – 3%	0 – 3%	4 – 12%
L.A. Abrasion Loss, Max.	40%	40%	40%	40%	40%

(1) The fraction passing the No. 200 sieve shall not be greater than two-thirds (2/3) of the fraction passing the No. 40 sieve. In no case shall the upper limit specified for the No. 200 sieve be exceeded.

117.3 SAMPLING AND TESTING

Sampling SD 201
Gradation SD 202
Liquid Limit and Plasticity Index SD 207
L.A. Abrasion Test..... AASHTO T 96

117.4 METHOD OF MEASUREMENT &

117.5 BASIS OF PAYMENT

Measurement and payment of aggregates for granular bases and surfacing shall be in accordance with Section 20 of these Specifications.

END OF SECTION

SECTION 118

ASPHALT MATERIAL

118.1 GENERAL REQUIREMENTS

Transporting conveyances for asphalt material shall be free of contaminating material. A record of material hauled the previous load in truck transport tanks shall be furnished to the Engineer as a prerequisite to loading. A determination shall be made if the previously hauled material is compatible with the material to be loaded or if cleaning of the tank is required to prevent contamination.

The company or jobber furnishing asphalt materials shall furnish two copies of a Certificate of Compliance for each tank car, truck tank or other individual conveyance.

Temperatures to provide Kinematic Viscosities of 300 centistokes and 150 centistokes for mixing application and 200 centistokes and 50 centistokes for spray application shall be furnished to the Engineer for each load of asphalt cement or cutback asphalt, on the Certificate of Compliance.

Upon presentation of a Certificate of Compliance, the Engineer may permit incorporation into the work the asphalt material covered by the Certificate. Permission by the Engineer to use asphalt material shall not be construed as an acceptance of the material. Acceptance of asphalt material will be based on test results of the samples obtained.

Asphalt material tested and accepted for use on a project and transferred by the Contractor to another project may be accepted for use in the terminating project based on the test results of the originating project. The Contractor must request and receive from the Engineer of the originating project, prior to transfer, a letter of transfer covering the material .

118.2 SPECIFIC REQUIREMENTS

- A. Rapid curing cutback asphalt shall conform to the requirements of AASHTO M81.
- B. Medium curing cutback asphalt shall conform to the requirements of AASHTO M82.
- C. Slow curing cutback asphalt shall conform to the following requirements:
 - 1. The oil shall be uniform in appearance and consistency and shall show no foaming when heated to the application temperature. The residue of specified penetration shall be smooth and homogeneous in appearance.

2. The grade of liquid asphalt material specified shall conform to the requirements shown in Table 1.

Table 1

REQUIREMENT	SC-70		SC-250		SC-800		SC-3000	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
Kinematic viscosity @ 60C (140F) (See Note 1) centistokes	70	140	250	500	800	1600	3000	6000
Flash Point (Cleveland open cut) Degrees C / (F)	66 150	---	79 175	---	93 200	---	107 225	---
Water Percent:	---	0.5	---	0.5	---	0.5	---	0.5
Asphalt residue of 100 pen., % by Weight	50	---	60	---	70	---	80	---
Ductility of 100 pen., residue @ 25C (77F), 5 cm per min., cm	100	---	100	---	100	---	100	---
Solubility in Trichloroethylene, %:	99.0	---	99.0	---	99.0	---	99.0	---
Distillation Test: Total distillate To 360C (680F), % by volume	10	30	4	20	2	12	---	5
Tests on residue from distillation: Kinematic viscosity at 60C (140F) Stokes	4	70	8	100	20	160	40	350

Spot Test (See Note 2) with:

Standard naphtha	Negative for all grades
Naphtha xylene solvent, % xylene	Negative for all grades
Heptane xylene solvent, % xylene	Negative for all grades

Footnotes

- 1) As an alternative, Saybolt-Furol viscosities may be specified as follows:

Grade SC-70	Furol viscosity at 50°C 60 to 120 sec.
Grade SC-250	Furol viscosity at 60°C 125 to 250 sec.
Grade SC-800	Furol viscosity at 82.2°C 100 to 200 sec.
Grade SC-3000	Furol viscosity at 82.2°C 300 to 600 sec.

- 2) The use of the spot test is optional. When specified, the Engineer shall indicate whether the standard naphtha solvent, the naphtha xylene solvent or the heptane xylene solvent will be used in determining compliance with the requirement and, in the case of xylene solvent, the percentage of xylene to be used.

D. Sampling and Testing

Sampling	SD 301
Water	AASHTO T 55
Flash Point	AASHTO T 48
Kinematic Viscosity	AASHTO T 201

Saybolt Furol Viscosity	AASHTO T 72
Residue of Specified Penetration	SD 310
Ductility	AASHTO T 51
Solubility in Trichloroethylene	AASHTO T 44
Distillation	AASHTO T 78

- E. Performance graded asphalt cement binder shall be used for all pavement within the City of Rapid City street right of way unless another binder is approved by the Engineer and is specified in the detailed specifications. Mainline street and intersection pavement shall utilize PG64-28 graded asphalt binder. Sidewalks, low traffic driveways, or areas where significant hand working is required may utilize PG64-22 or PG58-28 binders.

Performance Graded Asphalt Cement Binder shall conform to AASHTO Performance Graded Binder Specifications (MPI) and the Combined Stare Binder Group Method of Acceptance for Asphalt Binders.

Permissible modifiers for the Specific SHRP Performance Graded Asphalt Binder are Styrene-Butadiene Rubber (SBR) or Styrene-Butadiene-Styrene Rubber. Certified test results for the asphalt binder and modifier shall be provided for each load shipped to the project. The modifier shall be added at an approved blending plant.

The Contractor shall provide a Job-Mix Formula to the Engineer with supporting mix design data prior to production. The Engineer may require field adjustment of the asphalt binder content.

- F. Penetration Graded or Viscosity Graded Asphalt Cement Binder, where specified in the Detailed Specifications in lieu of Performance Graded Asphalt Binder shall conform to the requirements of AASHTO M 20 and AASHTO M 226 respectively.

When a penetration-graded asphalt cement is specified, the Contractor may furnish the comparable viscosity graded asphalt cement as set forth in the following table:

AASHTO M 226		AASHTO M 20	
AC - 2.5	for	200-300	
AC - 5	for	120-50	
AC - 10	for	85-100	
AC - 20	for	60-70	

The Certificate of Compliance for the asphalt cement furnished shall indicate by grade designation which grading specification (AASHTO \geq M 20 or AASHTO M 226) the material is certified to meet.

In the event asphalt cement is furnished simultaneously from sources to meet different grading specifications, the Engineer may require separate storage and use of the material from a source if viscosity characteristics of the two materials are not compatible at the same mixing temperature.

- G. Emulsified asphalt shall conform to the specification requirements of AASHTO M 140. When SS-1h Emulsified Asphalt is specified, the penetration of the residue from distillation shall be from 40 to 115 penetration and, when specified for tack or flush seal coat, the cement mixing test requirement is waived.
- H. Cationic Emulsified Asphalt shall conform to the specification requirements of AASHTO M 208. When CSS-1h is specified, the penetration of the residue from distillation shall be from 40 to 115 penetration and, when specified for tack or flush seal coat, the cement mixing test requirement is waived.
- I. Petroleum Resin-Oil Base Emulsion shall conform to the following requirements:

TEST	LIMITS		TEST METHOD
	MIN.	MAX.	
Saybolt-Furol Viscosity (at 77 deg. F. (second))	15	40	AASHTO T 59
Residue Percent	60		AASHTO T 59 (1)
Miscibility	No Coagulation		AASHTO T 59 (2)
Sieve Test		10	AASHTO T 59 (3)
Particle Charge	Positive		
Tests on Residue Kinematic Viscosity (at 140 deg. F.) centistokes	100	200	AASHTO T 201
Asphaltene Percent		75	ASTM D 2007
Maltenes Dist. Ratio	0.3	50	ASTM D 2007 (4)

PC + A1

S + A2

Footnotes

- (1) T 59 residue by evaporation test for percent residue is made by heating a 50-gram sample to 300° until foaming ceases, then immediately cooling sample and calculating results.
- (2) Test procedure identical with T 59, except Normal Calcium Chloride solution shall be used in place of distilled water.
- (3) Test procedure identical with T 59, except distilled water shall be used in place of 2% Sodium Oleate solution.

(4) In the Maltenes Distribution Ratio Test by ASTM D 2007:

PC = Polar Compounds A1 = First Acidaffins
A2 = Second Acidaffins S = Saturates

The material shall have the capability of increasing the ductility and penetration of the asphalt binder in the asphalt concrete surface when applied at the specified rate.

- J. Petroleum Resin-Oil Base Emulsion (Diluted) shall be diluted with potable water in the ratio of approximately two parts emulsion to one part water by volume.

The petroleum Resin-Oil Base Emulsion, prior to dilution, shall conform to the requirements of "G" above.

The diluted emulsion shall meet the following requirements:

TEST	LIMITS		TEST METHOD
	MIN.	MAX.	
Residue Percent	40		AASHTO T 59(1)
Sieve Test		10	AASHTO T 59(3)
Tests on Residue Kinematic Viscosity (at 140 deg. F.)			AASHTO T 201
centistokes	100	200	

See Paragraph I for Footnotes.

- K. "High Float" Emulsified Asphalt shall conform to the following requirements:

TABLE 1

TEST	GRADE AE150S		GRADE AE200S		GRADE AE300	
	MAX.	MIN.	MIN.	MAX.	MIN.	MAX.
Viscosity (Saybolt Furol) (at 122°F (50°C) Sec.)	35	150	35	150	35	500
Sieve Test – Percent		.30		.30		.30
Oil Portion Dist. (% by Volume)	.5	3	1	6		8
Residue by Dist. (% by Weight)	62		62		65	
Tests on Residue From Distillation Float Test (at 140°F (60°C) sec.)	1200		1200		1200	
Penetration (at 77°F, 100 q. 5 sec. – 0.1mm)	140	225	250		300	
Solubility in Trichloroethylene (%)	97.5		97.5		97.5	
Ductility (at 77°F, (25°C), 5 cm/min. – cm)	40		40		40	

The properties of the Emulsified Asphalt shall be determined in accordance with AASHTO T 59.

Float test properties on the residue from distillation shall be determined in accordance with AASHTO T 50.

118.3 TEST REPRODUCIBILITY TOLERANCE

Test results which fall outside the specifications limits for a particular test but within the reproducibility tolerance as set forth below, will be acceptable:

<u>TEST</u>	CUTBACK ASPHALT	<u>TOLERANCE*</u>
Flash Point		
Tag Open Cup		
(Av. of three tests).....		4°F
Cleveland Open Cup.....		15°F
Viscosity		
Kinematic, 140° F		
(to 3000 CS).....		1.5%
Kinematic, 140° F		
(above 3000 CS).....		4.5%
Saybolt-Furol.....		4.5%
Distillation		
Distillate % by vol.		
(up to 347° F).....		1.8% pts.
Distillate % by vol.		
(above 347° F).....		1.0% pt.
Residue % by vol.....		1.0% pt.
Test on Residue		
Penetration.....		8%
Solubility in CH ₃ CCl ₃		0.13% pt.
EMULSIFIED ASPHALTS		
Distillation		
Residue by % vol.....		1.0% pt.
Test on Residue		
Penetration (100 or more).....		15 pen pts.
Penetration (less than 100).....		8 pen pts.
ASPHALT CEMENT		
Penetration, 77° F		
(Less than 50).....		2 pen pts.
Penetration, 77° F (50 or above).....		4%
Flash Point		
Cleveland Open Cup.....		15° F

Pensky-Marten's Closed Cup (below 220° F).....	3° F
Pensky-Marten's Closed Cup (above 220° F).....	13° F
Viscosity	
Kinematic, 275° F	4.4%
Absolute, 140° F	5.0%
Solubility in Ch ₃ CCl ₃	0.13% pt.
Thin-Film Test	
Loss on Heating.....	20%
% of Original.....	4% pts.

* When tolerances are expressed in terms of percent, the allowable deviation is calculated as the indicated percentage of the upper or lower specification limit, whichever is applicable.

**118.4 METHOD OF MEASUREMENT &
118.5 BASIS OF PAYMENT**

Asphalt material will be measured and paid for in accordance with the various asphalt construction items.

END OF SECTION

SECTION 120

REINFORCED CONCRETE PIPE

120.1 REQUIREMENTS

Reinforced concrete pipe shall conform to the requirements of AASHTO M170, M206 and M207. The pipe and fittings shall be manufactured at a pre-cast facility that is certified by the American Concrete Pipe Association and is approved for supplying products to the South Dakota Department of Transportation.

A. Basis of Acceptance

The acceptability of the pipe will be determined based on plant load-bearing tests, compressive strength of concrete, materials tests, and inspection of the complete product, including installation, as required.

B. Related Work

Section 11	Utility Excavation & Backfill
Section 54	Pipe Culverts
Section 58	Pre-cast Concrete Box Culvert
Section 62	Drop Inlets
Section 63	Storm Sewer Manholes

120.2 MATERIALS

Materials shall conform to the requirement of the following sections:

1. Portland Cement shall be Type II, conforming to Section 100.
2. Water shall conform to Section 104.
3. Fine aggregate shall conform to Section 105.
4. Coarse aggregate shall conform to Section 107, except the gradation requirements shall not apply.
5. Reinforcement shall conform to Sections 57 & 123.
6. Air entraining admixtures shall conform to Section 101.
7. Chemical admixtures shall conform to Section 102.

120.3 CONSTRUCTION REQUIREMENTS

The concrete in special sections shall have a minimum compressive strength of 4000 psi. The strength shall be determined by test cylinders or by cores. Tests with the Swiss Hammer may be used to supplement the tests.

Pipe culverts and storm drains (storm sewers) shall be tested in accordance with the provisions contained in Section 54 – Pipe Culverts.

**120.4 METHOD OF MEASUREMENT &
120.5 BASIS OF PAYMENT**

Measurement and payment for reinforced concrete pipe culvert shall be as called for in Sections 54 and 58 of these Specifications.

END OF SECTION

SECTION 121

CORRUGATED METAL PIPE

121.1 REQUIREMENTS

- A. Corrugated metal pipe shall conform to the requirements of AASHTO M 36 or AASHTO M 196.
- B. Bituminous coated corrugated metal pipe shall conform to the requirements of AASHTO M 190, except the pipe shall conform to AASHTO M 36 OR AASHTO M 196 before coating.
- C. Related Work

Section 11	Utility Excavation & Backfill
Section 54	Pipe Culverts
Section 58	Pre-cast Concrete Box Culvert
Section 62	Drop Inlets
Section 63	Storm Sewer Manholes

121.2 CONSTRUCTION REQUIREMENTS

Pipe culverts and storm drains (storm sewers) shall be tested in accordance with the provisions contained in Section 54 – Pipe Culverts.

121.3 METHOD OF MEASUREMENT &

121.4 BASIS OF PAYMENT

Corrugated metal pipe will be measured and paid for in accordance with Section 54 and 58 of these specifications.

END OF SECTION

SECTION 123

REINFORCEMENT

123.1 REQUIREMENTS

- A. Bar reinforcement shall conform to the requirements of AASHTO M31
- B. Welded steel wire fabric shall conform to the requirement of AASHTO M55.
- C. Tie bars for concrete pavement shall conform to the requirements of AASHTO M31 Grade 40. Tie bars shall be deformed bars.
- D. Dowel bars for concrete pavement shall conform to AASHTO M31, M227 or M255 Grade 40 minimum. Dowel bars shall have an epoxy coating. The coating shall conform to AASHTO M284 except that the film thickness shall be 5 to 10 mils after cure. Dowel bars shall be plain round bars, free from burring or any other deformation which would restrict slippage in the concrete.

Shearing will be permitted, provided the coating is not damaged and subject to permissible deformation. Any deformation larger than true shape shall not exceed 0.40 in. increase in diameter or thickness and shall not extend more than 0.40 in. from the dowel end.

Asphaltic bond breakers that may be used to precoat dowel bar assemblies will include: MC-70, RC-70, RC-250, CRS-1, CRS-2, CSS-1h, HFMS-2, HFMS-2h, or HFMS-2s.

- E. Bar reinforcement for concrete pavement, except dowel and tie bars, shall conform to the requirements of AASHTO M31 Grade 60.
- F. Epoxy-coated reinforcement shall comply with AASHTO M284. A Certificate of Compliance and a copy of the quality control test results shall be furnished for each shipment supplied for use on a project.

123.2 METHOD OF MEASUREMENT & 123.3 BASIS OF PAYMENT

Reinforcement for concrete construction will be incidental to the various construction bid items. There will be no separate measurement and payment for reinforcement for concrete construction.

END OF SECTION

SECTION 124

FABRIC FORMED CONCRETE MAT MATERIAL

124.1 REQUIREMENTS

- A. Fabric Forming Material shall consist of specially woven multiple panels of double layer, open-selvage fabric joined in a mat configuration. The two (2) fabric layers shall each be no lighter than 18 x18 count/inch, 1000 denier nylon or 1000 denier polyester tire cord, of which at least 50 percent by weight shall be producer bulked continuous multifilament tire cord nylon. The porosity of the fabric, when tested in accordance with ASTM D 737, shall not be less than 100 cubic feet/minute/square foot. Fabric of equal or greater strength and comparable porosity may be used with approval. Fabric forming material shall bear the trademark of the manufacturer.

B. Fabric Forms

Individual mill width fabric panels shall be cut to suitable length and the two (2) layers of fabric separately joined edge to edge by double stitching with heavy nylon thread. The tensile strength of stitched joints shall be not less than 100 lbs. per inch.

1. Uniform Cross Section Fabric Forms shall consist of multiple panels of double layer, fabric joined by interwoven ties of the length required to provide the mat thickness specified and spaced no farther than three (3) inch centers.

Hydrostatic uplift pressure relief points shall be woven or sewn into the fabric envelopes at the center of each individual mill width and spaced a maximum of ten (10) feet longitudinally.

2. Relief Point Joined Fabric Forms shall consist of multiple panels of double layer fabric woven together on spaced centers to provide points for relief of hydrostatic uplift pressure.
3. Fabric Forms, regardless of type, shall meet the following requirements:
 - a. Points for relief of hydrostatic uplift pressure shall be of the configuration, size, and weave recommended by the manufacturer and shall be an integral feature of the fabric forms as received from the manufacturer.
 - b. Slurry stops to provide lateral containment of the slurry during injection of a section shall be provided as an integral feature of the forms.

C. Test Specimen

When a bid item, Fabric Mat Test Specimen, is provided in the contract, suitability of the fabric design shall be verified by the following test procedure:

At the start of the slurry injection of the placed forms or shortly thereafter, five (5) specimens, consisting of 5 ½ inches diameter by 24-inch long sleeves constructed of the same fabric used in individual form layers shall be injected with slurry under a pressure of 10 to 15 psi. The pressure shall be maintained by a standpipe or other acceptable means for ten (10) minutes. The specimens shall be cured under job site conditions for five (5) days.

Three companion test cylinders shall be made and cured in accordance with AASHTO T 23 at the same time the injected cylinders are made.

After the curing period, 5 ½ inches x 12 inches cylinders shall be cut from the middle of each injected specimen.

Three (3) specimens shall be tested for compressive strength at seven (7) days in accordance with AASHTO T 22. The three (3) companion test cylinders shall also be tested for compressive strength at this time.

The average seven (7) day compressive strength of the injected specimens shall be at least 20 percent higher than the average of the companion test cylinders. The remaining two (2) injected specimens, when tested at 28 days, shall have a minimum average compressive strength of 2500 psi.

The Contractor shall furnish labor, materials, and equipment to make the test specimens. The City will oversee and conduct required compressive strength testing of specimens.

124.2 METHOD OF MEASUREMENT &

124.3 BASIS OF PAYMENT

Concrete mat fabric forming material will be measured and paid for in accordance with Section 67 of these Specifications.

END OF SECTION

SECTION 125

GABIONS

125.1 REQUIREMENTS

Gabions shall be supplied in various lengths and heights. The lengths shall be multiples (2, 3, or 4) of the horizontal width. The heights shall be fractions (1, 1/2 or 1/3) of the horizontal width. The horizontal width shall not be less than 36 in. Gabions furnished by a manufacturer shall be of uniform width.

Gabions shall be fabricated so the sides, ends, lid and diaphragms can be assembled into a rectangular basket at the construction site. Gabions shall be of single unit construction. 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 so strength and flexibility at the point of connection is at least equal to that of the mesh.

The gabion shall be furnished with diaphragms the same mesh and gauge as the body of the gabions, secured in proper position on the base in such a manner that no additional tying now will be necessary. The spacing of the diaphragms shall be the same as the horizontal width.

Perimeter edges of the mesh that forms the gabion shall be securely selvaged so the joints formed by tying selvages have at least the same strength as the body of the mesh.

Tie wire or connecting wire shall securely fasten all edges of the gabion and diaphragms to provide for four internal connecting wires in each cell one-half unit high and eight internal wires in each cell one unit high. The tie wire shall meet the same specifications as the wire used in the mesh except that it may be two gauges smaller.

The wire mesh shall have elasticity permitting elongation to a minimum of 10% of the length of the section of the mesh without reducing the gauge or tensile strength of individual wires to values less than those for wire one gauge smaller.

A section of the mesh 6 feet long and not less than 3 feet wide, after the elongation test, shall withstand a load test of 6,000 pounds applied to an area of one square foot in the center of the section.

An uncut section of mesh 6 feet long and not less than 3 feet wide, including selvedge bindings, shall have the ends securely clamped for 3 feet along the width of the sample. When the width of the sample exceeds 3 feet, the clamps will be placed in the middle and the excess width will fall free on each side of the clamped section.

The sample shall be subjected to sufficient tension to cause 10% elongation of the section between the clamps. After elongation and while clamped, the section shall be

subjected to a load applied to an area of one square foot in the center of the sample section and perpendicular to the direction of the tension force. The sample shall withstand an actual load of 6,000 pounds without rupture of wire or opening of mesh fastening. The ram head used in the test shall be circular with its edges beveled or rounded to prevent cutting of the wires.

The wire mesh shall resist pulling apart at the twists or connections, which form the mesh when a single wire is cut and the section of mesh is then subjected to the load test described in the elasticity test.

Each shipment of gabions shall be accompanied by a certificate, which states that the material conforms to the requirements. A shipment shall consist of all material arriving at the job site at substantially the same time. The certificate shall be on company letterhead and shall be signed by an officer of the company who has legal authority to bind the company.

**125.2 METHOD OF MEASUREMENT &
125.3 BASIS OF PAYMENT**

Measurement and payment for gabion baskets will be in accordance with Section 69 of these Specifications.

END OF SECTION

SECTION 126

WOOD PRESERVATIVES AND PRESERVATIVE TREATMENTS

126.1 REQUIREMENTS

Piling shall be treated with Creosote, Copper Naphthenate or Pentachlorophenol. Round posts, sawed posts and lumber in contact with the ground shall be treated with Ammoniacal Copper Zinc Arsenate, Creosote, Copper Naphthenate, Pentachlorophenol or Chromated Copper Arsenate.

Lumber not in contact with the ground shall be treated with Ammoniacal Copper Zinc Arsenate, Pentachlorophenol, Copper Naphthenate or Chromated Copper Arsenate. Preservative treatment shall be in accordance with APWA Standards AASHTO M133 and with the following table:

SPECIE	PILES		POSTS	
	PENETRATION	PERCENT	PENETRATION	PERCENT
Douglas Fir	0.75 (max. of 1.60)	85	0.375 (up to 1.00)	100
Western Hemlock			0.375 (up to 1.00)	100
Western Larch	0.75 (max. of 1.60)	85	0.375 (up to 1.00)	100
Jack Pine	1.50	85	1.5	85
Lodgepole Pine	0.75 (max. of 1.60)	85	1.25	85
Ponderosa Pine, Red Pine, Southern Pine	2.5	85	2	85

126.2 METHOD OF MEASUREMENT & 126.3 BASIS OF PAYMENT

Wood preservatives and preservative treatments will be incidental to the various construction bid items and therefore will have no separate measurement or payment.

END OF SECTION

SECTION 145

BRIDGE REPAINTING AND RESIDUE CONTAINMENT

145.1 DESCRIPTION

This work consists of preparing the metal surfaces of previously painted structures, containment of residue and application of prescribed coats of paint. Work shall be in accordance with Section 412 of the South Dakota Department of Transportation Standard Specifications for Roads and Bridges most current edition.

END OF SECTION

SECTION 146

EROSION TREATMENT MATERIAL

146.1 DESCRIPTION

A. General

This work consists of shaping slope drains, ditches, medians or other waterway channels and applying erosion treatment material.

B. Related Work Items

Section 11	Utility Excavation and Backfill
Section 12	Roadway and Drainage Excavation
Section 14	Embankment
Section 17	Salvaging, Stockpiling and Placing Topsoil
Section 18	Erosion and Water Pollution Control
Section 65	Riprap
Section 66	Slope Protection
Section 68	Bank and Channel Protection Rock Filled Wire Baskets
Section 69	Bank Protection Gabions
Section 70	Seeding
Section 71	Fertilizing
Section 72	Mulching
Section 109	Riprap and Slope Materials
Section 202	Engineering Fabric

146.2 MATERIALS

A. Fiberglass Roving

Fiberglass roving shall be formed from continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound, collected into strands and lightly bound together into roving without the use of clay, starch or like deleterious substances.

The roving shall be wound into a cylindrical package approximately one foot high in such a manner that the roving can be continuously fed from the center of the package, through an ejector driven by compressed air and expanded into a mat of glass fiber on the soil surface.

The material shall contain no petroleum solvents or other agents known to be toxic to plant or animal life.

B. Erosion Control Blankets or Turf Reinforcement Mats (TRMs)

Description

Erosion-control blankets are biodegradable, open-weave blankets used for establishing and reinforcing vegetation on slopes, ditch bottoms and shorelines. Erosion-control blankets and TRMs, are especially useful in critical areas such as swales, long channels and slopes steeper than 3:1.

Design**Erosion Control Blankets**

Several categories are provided with different service application and specific uses as shown in the **Erosion Control Blanket Fabric Category Table** below.

Erosion Control Blanket Fabric Category Table

Category	Service Application	Use	Acceptable Types
1	Very Temporary	Flat areas, shoulder drain outlets, roadway shoulders, lawns, mowed areas.	Straw, wood fiber, rapidly degradable netting on one side
2	One Season	Slopes 3:1 and steeper less than 50 ft long, ditches with gradients 2% or less, flow velocities less than 5.0 fps.	Straw, wood fiber, netting on one side
3	One Season	Slopes 3:1 and steeper, more than 50 ft long, ditches with gradients 3% or less, flow velocities less than 6.5 fps.	Straw, wood fiber, netting on one side
4	Semipermanent	Ditches with gradients 4% or less, flow velocities less than 8.0 fps, flow depth 6 inches or less.	Straw/coconut, wood fiber, netting on two sides
5	Semipermanent	Ditches with	Coconut fiber,

		gradients 8% or less, flow velocities less than 15.0 fps and flow depth less than 8 inches, watercourse banks within the normal flow elevation.	netting on two sides
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Erosion-control blankets shall consist of a uniform web of interlocking fibers with net backing. The blanket shall be of uniform thickness, with the material fibers being evenly distributed over the area of the blanket. The blankets shall be porous enough to promote plant growth yet shield the underlying soil surface from erosion. All material shall have been properly cured to achieve curled and barbed fibers. All blankets shall be smolder resistant.

The net backing on each blanket shall consist of polypropylene mesh. For Category 1 blankets, the net backing should start to decompose after one month with 80% breakdown occurring within three months. For Category 2 and 3 blankets, the netting should contain sufficient UV stabilization for breakdown to occur within a normal growing season. For Category 4 and 5 blankets, the netting should be UV stabilized to provide a service life of two to three years.

Install erosion-control blankets per manufacturer’s recommendations.

Turf-Reinforcement Mats (TRMs)

Turf-reinforcement mats are synthetic, non-degradable mats that are usually buried to add stability to soils. They come in a wide range of designs and have been proven to be valuable on slopes and in channel-lining applications.

TRMs consisting of non-degradable , three-dimensional matrix materials should be used with expected velocities of 15 fps and shear stress of 8lbs/sf. Beyond these velocities and shears, vegetated structures such as articulated block, cable concrete and cribwalls, should be considered.

Install TRMs per manufacturer’s recommendations.

Maintenance

Inspect erosion-control blankets and TRMs periodically, and after rainstorms to check for rill erosion, dislocation or failure. Where erosion is observed, repair or replace fabric.

Continue inspections until vegetation is established.

If washout occurs, repair the slope grade, reseed and reinstall fabric.

C. Staples

Staples shall be U-shaped and shall be approximately six inches long and one inch wide. Staples shall be 11 gage or heavier ungalvanized steel wire. Where 11 gage staples cannot be driven without bending, 9 gage or heavier ungalvanized steel wire staples will be required.

D. T-pins

T-pins shall be #6 bright wire T-pins consisting of a 12-inch long top bar and a minimum 9-inch leg. The top bar may be welded to the top at the side of the 9-inch leg or the T-pins may be machine bent to the proper configuration.

E. Erosion Bales

Erosion bales shall consist of hay or straw bales substantially free of weeds and a nominal size of 15 inches x 18 inches x 4 feet.

F. Erosion Bale Anchors

Erosion bales shall be anchored with #4 rebar 3 feet long or with 2 inch x 2 inch x 3 feet wood pegs.

G. G. Silt Fence

Description

A silt fence is a temporary barrier designed to retain sediment on the construction site. It consists of a geotextile attached to supporting posts that are trenched into the ground. The fence retains sediment primarily by retarding flow and promoting deposition on the uphill side of the fence. Runoff is also filtered as it passes through the geotextile.

Design

Install silt fences on the contour and construct so that flow cannot bypass the ends.

Ensure that the drainage area is no greater than $\frac{1}{4}$ acre per 100 feet of fence.

The use of silt fence as a sediment barrier shall not be used in areas of concentrated flow, such as ditches.

Ensure that the depth of impounded water does not exceed 2 feet at any point along the fence.

The fence must be tied into the slope so that the base of the fence is above the design storage depth.

When plastic mesh is used on the heavy duty silt fence, the mesh backing shall be joined to the geotextile at the top with two rows of stitching.

A 1 foot high by 2 foot wide berm of compost can be placed at the base of the sediment fence over the fabric lip. Placing the compost over the fabric fence lip eliminates the need to trench and bury the fabric. The compost particle sizes shall be the following: 3 inch-100% passing, 1 inch-90% to 100% passing, ¾ inch-70% to 100% passing, ¼ inch-30% to 75% passing, maximum particle length of 6 inches.

Alternately, a compost berm may be placed in lieu of silt fence. The berm shall be a minimum of 2 feet high by 4 feet wide. The particle sizes shall be the following: 3 inch-100% passing, 1 inch-90% to 100% passing, ¾ inch-70% to 100% passing, ¼ inch-30% to 75% passing, maximum particle length of 6 inches.

Maximum allowable slope lengths contributing runoff to a silt fence are listed in the **Silt Fence Slope Criteria Table**.

Silt Fence Slope Criteria Table

Constructed Slope	Maximum Slope Length (feet)
2H:1V	50
3H:1V	75
4H:1V	125
5H:1V	175
Flatter than 5H:1V	200

Types

The following three types of silt fences are designated for use based on conditions. For details on each type of fence see the **Silt Fence Specifications Table**.

Heavy Duty: Use at locations where extra strength is required, such as near water bodies; on areas with unstable wetland soils, steep slopes, highly erodible soils or high runoff; and on areas that are inaccessible to equipment.

Preassembled: For light-duty applications, to protect temporary construction or to supplement the other types of silt fence. This type is installed with plow-type equipment with pre-attached stakes spread at 6 to 8 foot intervals.

Machine-Sliced Installation: Appropriate for general use during site grading and to protect critical areas.

Silt Fence Specifications Table

	Heavy Duty		Machine Sliced	Preassembled
Description	Composite of mesh backing, posts, geotextile and fasteners, assembled		Machine installed geotextile fastened to posts on site	Ready-to-install geotextile attached to driveable posts
Geotextile				
Type	Woven		Woven Monofilament	Woven
Width	48 inches		36 inches	36 inches
Grab Tensile ASTM C4632	100 lb. minimum		130 lb. minimum	100 lb. minimum
Apparent Opening Size ASTM D4751	#20-70 sieve		#30-40 sieve	#20-70 sieve
UV Stability ASTM D4355 500 hours	70 percent minimum		70 percent minimum	70 percent minimum
Flow Rate ASTM D4491 gal/min/sf	NA		100 gal/min/sf	NA
Top Fastening Component	6-inch overlap, top of mesh backing		Selvaged edge	Sewn-in cord
Net Backing				
Material	Woven wire mesh	Plastic mesh	NA	NA
Steel Wire Gauge	14 min.	NA	NA	NA
Max. Mesh Opening	6 inches	2 inches	NA	NA
Rope for Ditch Check				
Type	NA		Polyethylene	NA
Diameter	NA		5/8-inch minimum	NA
Posts				
Material	Steel T-post		Steel T-post with welded plate	Wood
Minimum Size	1.26 lbs/in/ft		1.26 lbs/in/ft	2 x 2 inch
Minimum Length	5 feet		5 feet	5 feet

Min. Embedment	24 inches	24 inches	18 inches
Maximum Spacing	8 feet	6 feet	6 feet
Post Fastener	U-shaped clips	Plastic zip ties, 50 lb. tensile strength	Gun staples
Minimum Fasteners per post	3(for both woven wire and mesh)	3	5
Minimum Fastener Spacing on post	2 foot	1 foot	1 foot

See the **Silt Fence Detail 146-1**.

Maintenance

Inspect silt fences at least once a week and after each rainfall, or as required by the NPDES permit. Make any required repairs immediately. Repair scoured areas on the back side of the fence at this time to prevent future problems.

Replace silt fence fabric that has torn, collapsed, decomposed or otherwise become ineffective within 24 hours of discovery.

Remove silt deposits once they reach 30 percent of the height of the fence to provide storage volume for the next rain and to reduce pressure on the fence.

Silt fences are to be removed upon stabilization of the contributing drainage area. Accumulated sediment may be spread to form a surface for turf or other vegetation establishment, or disposed of elsewhere. The area should be reshaped to permit natural drainage.

146.3 CONSTRUCTION REQUIREMENTS

A. General

This work shall be done as soon as possible after finish grading and topsoiling is completed and, if practical, prior to seeding, fertilizing and mulching of adjacent areas.

Seasonal limitations on the installation of erosion treatment materials shall be as described in Section 70.3.

The Contractor is responsible for inspecting the erosion control materials and measures on a regular basis and after every runoff event during the construction period to insure proper function. The Contractor shall maintain areas where erosion materials and measures have been used until work on the project has been

completed and accepted. Prior to final acceptance of work, the Contractor shall repair and replace any damaged areas to the satisfaction of the Engineer.

At the end of the 2-year warranty period, the Engineer and Contractor shall inspect the erosion control devices and will determine whether or not erosion control should be removed. Removal will be at the Contractors expense. If vegetated areas are disturbed by the removal, they shall be restored at the Contractors expense. If the Engineer determines that erosion control should remain, then the City shall remove the erosion control when vegetation adequately established.

B. Preparation of Areas to be treated

1. Shaping

Ditches and drainages shall be reshaped to their typical section or to the ditch liner material. Material shall be laid in ditches and drainages to the widths specified.

When watercourses leading out of ditches are shallow or not well defined, special channels shall be constructed and undercut to allow for placement of topsoil.

The material shall be placed below edges of channels and excavated material drifted back away from the edges of the material to direct flow directly into the treated waterway.

2. Top soiling

Topsoil shall be spread to the depths specified over reshaped areas in accordance with Section 17 - Salvaging, Stockpiling and Placing Topsoil.

3. Condition Of Finished Surface

Rocks or clods over 1 1/2 inches in diameter and other foreign material shall be removed prior to placing material.

C. Seeding, Fertilizing and Mulching

Immediately after the area to be treated has been shaped and smoothed and prior to placing, the areas to be treated shall be seeded and fertilized as prescribed in Sections 70 - Seeding, 71 - Fertilizing, and 72 - Mulching.

Broadcasting, raking or dragging in of seed and fertilizer will be permitted on areas where a drill cannot operate satisfactorily.

D. Application of Erosion Control Blanket or Turf Reinforcement Mat (TRM)

Install erosion control blankets and turf reinforcement mats per manufacturers recommendations.

E. Application Of Fiberglass Roving

Fiberglass roving shall be applied over the designated area within 24 hours after normal seeding operations have been completed. Fiberglass roving shall be spread uniformly over the designated area to form a random mat of continuous glass fibers at the rate of 0.25 to 0.35 pound per square yard. This rate may be varied as directed by the Engineer.

Fiberglass roving shall be anchored to the ground with an emulsified asphalt Type SS-1 or CS-1 applied uniformly over the glass fibers at the rate of 0.25 to 0.35 gallon per square yard. This rate may be varied as directed by the Engineer.

Placement of asphalt will not be permitted when the air temperature is lower than 40°F.

The upgrade end of the lining shall be buried to a depth of one foot to prevent undermining.

F. F. Erosion Bales

Erosion bales shall be located as specified or as determined by the Engineer.

Each erosion bale shall be anchored in place with two anchor devices.

G. Silt Fence

Silt fence intended to limit soil migration due to precipitation runoff shall be installed perpendicular to ground slope and at intervals necessary to prevent excessive soil migration by capturing the majority of waterborne soil particles and reducing the velocity of the runoff water. Such installation may include excavation of silt traps upstream of the fence as called for on the contract documents. (See the Silt Fence Slope Criteria Table, Silt Fence Specifications Table, and Standard Detail 146-1).

146.4 METHOD OF MEASUREMENT

- A. Excelsior blanket will be measured to the nearest square yard. Measurement of the overlap and top and bottom folds will not be made. Contractors shall replace excelsior blanket that is damaged from causes beyond their control and they shall add the replacement quantity to the original quantities used. Excelsior blanket damaged by actions taken by the Contractor shall be replaced by the Contractor at no additional cost.
- B. Fiber mulching will be measured to the nearest one-tenth ton of satisfactory mulch applied. Contractors shall replace fiber mulching that is damaged from causes beyond their control and the replacement quantity shall be added to the original

quantities used. Fiber mulching damaged by actions taken by the Contractor shall be replaced by the Contractor at no additional cost.

- C. Fiberglass roving with the asphalt anchor will be measured to the nearest square yard (surface measurement) complete in place and accepted. Contractors shall replace fiberglass roving that is damaged from causes beyond their control and the replacement quantity shall be added to the original quantity used. Fiberglass roving damaged by actions taken by the Contractor shall be replaced by the Contractor at no additional cost.
- D. Erosion bales will be measured by the actual count of the bales placed.
- E. Silt fence will be measured by the lineal foot, inclusive of silt traps as required.

146.5 BASIS OF PAYMENT

- A. Excelsior blanket will be paid for at the contract unit price per square yard. Payment will be full compensation for shaping and finishing ditches and channels, which are not specifically addressed with the item "Ditch Shaping", installing material and the furnishing of labor, equipment, staples, material and incidentals necessary.
- B. Fiber mulching will be paid for at the contract unit price per ton for fiber mulching. Payment shall be full compensation for furnishing and placing, and for all labor, equipment and incidentals necessary.
- C. Fiberglass roving with the asphalt anchor will be paid for at the contract unit price per square yard. Payment will be full compensation for furnishing, installing and all labor, equipment and incidentals necessary.
- D. Erosion bales will be paid for at the contract unit price per bale. Payment will be full compensation for furnishing, installing and all labor, equipment and incidentals necessary.
- E. Topsoil will be paid for as provided in Section 11 and Section 14.
- F. Seed and fertilizer will be paid for as provided in Section 70 and Section 71.
- G. Silt fence will be paid by the lineal foot.

END OF SECTION

SECTION 190

WATERING

190.1 DESCRIPTION

This work consists of furnishing and applying water either directly on the road or to the materials being incorporated in the work.

These provisions do not apply to any water used in the production or curing of concrete.

190.2 MATERIALS

The water shall be furnished by the Contractor and shall be free from injurious matter.

190.3 CONSTRUCTION REQUIREMENTS

Watering may be accomplished by sprinkling, pre-irrigation, pre-mixing or by other methods approved by the Engineer. The contractor shall make every reasonable effort to minimize fugitive dirt or dust because of construction activities. The Engineer may require the Contractor to water or take other actions necessary to prevent blowing dirt and/or dust and other nuisance conditions.

A. Sprinkling

Sufficient equipment shall be available to apply the amount of water required to secure the proper compaction before evaporation, absorption or drainage prevents or interferes with the specified results to be obtained.

The moisture content of the material shall be uniform throughout the full depth and extent of each layer. Excess moisture in the material shall be removed by drying operations. The drying under such circumstances shall be carried on until the required moisture content is attained for compaction and without additional compensation.

B. Pre-Irrigation

Pre-irrigation of excavation areas shall be under the control of the Engineer. The Engineer shall have the authority to prohibit or stop pre-irrigation when wind, temperature or soil conditions are such that satisfactory results cannot be obtained.

The Contractor shall furnish to the Engineer the manufacturer's charts for recommended pressure, rate of discharge and effective area of irrigation for the various nozzles to be used. The pressure at the sprinkler head or nozzle shall be

adjusted to minimize atomization and subsequent evaporation. The recommendation of the manufacturer shall be followed. The use of pressure reducing valves may be required to maintain uniform nozzle pressure.

Prior to pre-irrigation, the Contractor shall drill test holes to the depth and spacing required over the area to be watered to determine the average natural moisture percentage present in the soil and the average optimum moisture requirement. Unless otherwise permitted, drill holes shall be at least 6 in. in diameter.

The Contractor shall furnish the Engineer, for review, a detailed layout showing the limits of excavation, sprinkler placement, depth of cut to be watered by each sprinkler and the anticipated length of operating time of each sprinkler.

This layout shall be drawn to scale using 1 in. equals one-half the diameter of nozzle coverage (in feet).

The natural vegetation on the area to be watered shall be left in place until all watering of the area has been completed. Vegetation on the watered areas shall be removed or the growth substantially halted within a reasonable time after watering. The Contractor shall perform necessary measures to keep future vegetation growth to a minimum.

Should soil or vegetation conditions warrant, the Engineer may require the Contractor to rip areas to be pre-irrigated. Such ripping shall be along the contour of the ground to a minimum depth of 2 feet.

Pre-irrigated areas shall not be excavated until a sufficient time has elapsed, normally about one day per foot of excavation depth, to allow the water to penetrate to the lower levels of the cut.

Prior to the start of grading operations, the Contractor shall drill test holes in the pre-irrigated areas to check the penetration of moisture.

C. Pre-Mixing

Water added to the material before delivery or placement on the roadbed shall be mixed uniformly into the material. The amount of water added shall be carefully controlled to conform to the requirements of the particular item of work.

D. Equipment Loading/Filling

Equipment filled from City water mains or other potable water systems shall be equipped with an air gap or backflow preventer to prevent backflow into the potable water system.

190.4 METHOD OF MEASUREMENT

Where a separate bid item for water is included in the bid proposal water will be measured by the thousand-gallon (MGal.) to the nearest one-tenth MGal. and will be furnished and applied as specified herein.

Measurement may be made by means of calibrated tanks or by approved metering devices, which record in U.S. gallons.

Prior to use of any meter used for measurement for payment purposes, the Contractor shall furnish the Engineer a certified statement that such meter conforms to Standard AWWA requirements. The statement shall show that the meter has been calibrated within the past year; however, should subsequent measurements prove the meter measurement unreliable, another certified meter producing satisfactory measurements shall be furnished for use. The head of each meter shall be sealed when calibrated, and the absence of such seal shall be just cause to prohibit the use of the meter.

Quantities of water measured by meters, which are accurate within the tolerance specified in AWWA, will be accepted without adjustment for meter error.

Authority for deduction of water lost through carelessness of the Contractor or otherwise wasted will be vested solely in the Engineer.

Where no separate bid item for water is included, payment shall be incidental to the items requiring water and no measurement will be made.

190.5 BASIS OF PAYMENT

Watering will be paid for at the contract unit price per thousand gallons (MGal.).

Payment will be full compensation for equipment, labor and incidentals necessary to complete the work as specified.

Where no separate bid item for water is included, payment shall be incidental to the items requiring water and no payment will be made.

END OF SECTION

SECTION 200

CONTROLLED LOW STRENGTH MATERIAL

200.1 DESCRIPTION

A. General:

This work shall consist of furnishing and placing a flowable mortar fill material at the locations shown on the drawings or as directed by the Engineer.

B. Related Work:

Section 8	Water Mains
Section 9	Sewer Mains
Section 11	Utility Excavation and Backfill
Section 55	Concrete Masonry
Section 100	Portland cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 104	Water for Use in Portland cement Concrete
Section 105	Fine Aggregate for Use in Portland cement Concrete
Section 106	Masonry Mortar Sand and Epoxy Resin Mortar Sand
Section 107	Coarse Aggregate for Use in Portland cement Concrete

200.2 MATERIALS

- A. Cement shall be Type I and shall comply with the requirements of Section 100 of these Specifications.
- B. Fly Ash shall meet the requirements of ASTM C-618, Class C.
- C. Aggregate shall meet the requirements of Sections 105, 106 and 107 of these Specifications. Sand shall be fine sand that will stay in suspension during placement and setting. The suggested gradation of the aggregate is as follows:

<u>Sieve Size</u>	<u>% Passing</u>
¾ inch	100
200	0-10

D. Mix Design:

Controlled low strength material shall achieve sufficient aggregate bond for adequate compressive strength to support anticipated loads. The compressive strength may be higher for material used strictly as structural backfill and as indicated in the detailed specifications for a specific project.

Controlled low strength material utilized for “water main encasement” and “sewer main encasement” shall achieve sufficient aggregate bond for adequate compressive strength to support the utilities and other anticipated loads. The compressive strength of the material after curing shall remain in a condition that it can be readily removed utilizing hand tools and small excavating equipment. A minimum and/or maximum compressive strength requirement may be specified for the product in the detailed specifications for a specific project.

Controlled low strength material shall obtain a minimum 28-day bearing strength of seventy-five (75) pounds per square inch and shall achieve a twenty (20) pounds per square inch bearing strength prior to backfilling on the material.

The suggested mix design for controlled low strength material is as follows:

Quantity of Dry Material per Cubic Yard

Cement	100 pounds (minimum)
Fly Ash	300 pounds
Aggregate	2800-2600 pounds

The weight of cement and fly ash shall be adjusted to achieve adequate compressive strength. The amount of water shall be such that the material flows properly without excessive segregation.

These quantities of dry materials, mixed with an appropriate quantity of water (approximately 50-70 gallons), should yield approximately one (1) cubic yard of controlled low strength material.

The Contractor may submit alternate mix designs to the Engineer for approval prior to placement of the controlled low strength material. The Engineer reserves the right to reject the mixed material if a flowable mortar suitable for placement cannot be produced.

200.3 PROPORTIONING AND MIXING EQUIPMENT

The proportioning and mixing equipment shall meet the requirements of Section 55 of these Standard Specifications.

200.4 CONSTRUCTION REQUIREMENTS

A. Placement:

Controlled low strength material may be placed into the area to be filled directly from the mixer truck, by pumping or by any other reasonable means. Controlled low strength material shall not be placed upon frozen ground, snow or ice.

If proposed depth of controlled low strength material fill warrants, the material shall be placed in layers. Maximum lift thickness shall be three (3) feet, except where such thickness would cause lifting or displacement of the utility, pipe or structure. In such case, depth of controlled low strength material fill shall be limited to prevent displacement of culverts, pipe or other structures. If possible, both sides of the structure shall be filled simultaneously to avoid displacement. If it is not possible to fill both sides simultaneously, fill shall be alternated side to side in shallow lifts. Each filling stage shall be as continuous as possible to prevent cold joints. Additional lifts shall not be placed until the material has lost sufficient moisture to walk on without indenting more than two inches.

B. Temperature Limitations:

Batching, mixing and placing may be started when air temperature is at least thirty-four (34°) degrees F and rising. Material temperature at time of placement shall be a minimum of forty (40°) degrees F.

C. Backfill:

Backfilling and compacting on top of the in-place controlled low strength material shall not proceed until the in-place material achieves a minimum bearing strength of twenty (20) pounds per square inch.

D. Protection:

The in-place controlled low strength material shall be protected in accordance with Section 55 of these Specifications, except that the temperature shall be maintained at fifty (50°) degrees F or above for a period of twenty-four (24) hours or until the strength requirement is met and backfill is completed.

200.5 METHOD OF MEASUREMENT

Controlled low strength material shall be measured to the nearest cubic yard of material placed, unless other measurement provisions are specified. Measurement provisions shall be consistent with the Bid Proposal. In lieu of actual field measurement for volume of material placed, truck delivery tickets will be used.

200.6 BASIS OF PAYMENT

Controlled low strength material will be paid at the unit price established in the Bid Proposal.

END OF SECTION

SECTION 201

CONSTRUCTION STAKES, LINES AND GRADES (CONTRACTOR FURNISHED STAKING)

201.1 DESCRIPTION

A. General:

This work shall consist of furnishing and placing construction stakes necessary to construct the project. The staking work includes establishing project centerline; re-establishing plan benchmarks; setting additional benchmarks as needed; taking cross sections of all topsoil stockpiles; taking final cross sections for earthwork quantities at the slope stake stations and plus stations or utilizing radial survey methods to establish same; verifying undercut, muck, rock and dig-out removal quantities; staking right-of-way (ROW), easements, and project limits; and miscellaneous construction survey work.

The Contractor shall perform all construction layout and reference staking necessary for accurate control and completion of all structures, grading, paving, drainage, fence, permanent benchmarks, ROW monuments and all other appurtenances required for the complete construction and acceptance of the work. The layout shall include, but not be limited to, staking clearing line; removal limits; slope staking and slope stake referencing; grade staking (blue top dirt grade and base course grade hubs); paving hub staking; staking of water mains, fittings, hydrants and valves; staking of sewer mains, bends, manholes, and services; staking of culvert pipes and structures; re-establishing property corners; and performing the miscellaneous staking as described in the plans and in these specifications.

The City will establish horizontal and vertical control as shown on the City-provided plans for those projects with a bid item for Contractor Furnished Staking.

To expedite the staking, the Contractor may obtain a conditional Notice To Proceed from the Engineer to begin staking operations prior to actual construction operations. Such conditional approval shall not be considered the start of the project day count. The Contractor shall not begin actual work on the project until a complete Notice To Proceed is received, at which point the project day count will begin.

B. Related Work:

Section 8 Water Piping Systems
Section 9 Sanitary Sewer
Section 11 Utility Excavation and Backfill

201.2 MATERIALS

- A. The Contractor shall furnish all staking materials of adequate quality for the purpose intended, including all stakes, stake chasers, paint, field note books, and all other materials necessary to properly perform the required work.
- B. Stakes shall be suitable for general field construction staking and shall be durable enough to last the duration of the project without undue weathering so as to make the stake illegible or difficult to read or use. Stakes that become illegible shall be remarked or reset at the Contractor's expense.
- C. Paint, when used in lieu of plastic flagging to mark survey stakes, shall be brightly colored or fluorescent to be visible from passing equipment. Paint that becomes faded shall be remarked or reset at the Contractor's expense.

Plastic flagging shall be brightly colored or fluorescent plastic ribbon securely tied to the survey stake. Plastic flagging that becomes faded, torn or dislodged shall be replaced at the Contractor's expense.

- D. Property pins/markers shall meet current South Dakota requirements for legal property monuments and shall be stamped with the licensed surveyor's number.
- E. Field note books shall be made of quality, heavy, water resistant paper and may be bound with a permanent binding or may be in loose leaf binding. Notes shall be made with a waterproof pen or pencil.

201.3 CONSTRUCTION REQUIREMENTS

- A. General:

The work shall be done by or under the supervision of a South Dakota Licensed Land Surveyor or a South Dakota Professional Engineer who is experienced and competent in urban street and road construction surveying and staking. The Land Surveyor or Professional Engineer shall be available to review work, resolve problems and make decisions in a timely manner. A crew chief, who is competent to perform all required surveying duties and who is under the direct supervision of the surveyor or engineer, shall be onsite to supervise and/or perform the staking in the absence of the surveyor or engineer on the project.

The Contractor shall submit qualifications and work experience history of the surveyor or engineer who will be supervising the construction survey work. This information shall be submitted two weeks prior to beginning the staking for review by the engineer.

If necessary, a South Dakota Registered Land Surveyor will be required to re-establish property corners as required by South Dakota Law. The Contractor shall

submit the name and registration number of the land surveyor who will perform the corner and monument relocation work on the project.

The Contractor shall also submit a proposed starting date of the staking and the anticipated surveying work schedule, and these dates must be consistent with the anticipated construction work schedule.

All stakes, references, line, grades, and batter boards required shall be furnished, set, and properly referenced by the Contractor's surveyor or engineer. The survey and staking shall be consistent with standard engineering practices and shall be approved by the Engineer.

The Contractor, through the Contractor's surveyor or engineer, shall be responsible for the accuracy of the staking. All errors and discrepancies found on previous surveys, plans, or specifications shall be called to the attention of the Engineer prior to proceeding with further survey and construction work.

The overall supervision of the construction staking personnel shall be the responsibility of the Contractor. Any deficient survey layout or staking performed by the Contractor's surveyor or engineer, or any unreported errors in previous surveys that may result in construction errors, shall be corrected by the Contractor at no additional cost to the City.

Field notes shall be kept in conventional, handwritten note books or in a computerized form acceptable to the Engineer. Notes shall be kept in a clear, orderly and neat manner, with all pertinent information duly noted therein. The note books shall become the property of the City upon completion of the project. The field notes are subject to inspection and review by the Engineer at any time during the project.

If required, final cross sections (terrain data), where required, shall be submitted to the Engineer in an electronic file compatible with City survey and computer equipment. The Contractor shall convert the terrain data, as necessary, to suitable format compatibility at no additional expense to the City prior to submittal. Printed cross sections showing original sections and as-constructed data shall be submitted, where required, to the Engineer upon completion of the project.

The Contractor shall be responsible for the placement and preservation of ties and references to all control points which are necessary for the accurate re-establishment of all benchmarks, base line(s), centerline(s) and property pins and ROW markers shown on the plans or found on or adjacent to the project. Prior to construction, a licensed land surveyor shall verify existing property pins or lost property pins and record his findings for all possible property pin locations within the construction limits.

The establishment of permanent bench levels and permanent alignment points will be furnished as a contract item in the proposal when required. The Contractor shall stake the locations of the benchmarks as called for on the plans or as directed by the Engineer. The City will establish the elevations and coordinates at a later date.

Stakes which are damaged, destroyed or made unusable during construction shall be replaced by the Contractor at no additional expense to the City.

The engineer may check the accuracy and control of the Contractor's survey work at any time. The checks performed by the Engineer will not relieve the Contractor of the responsibility for the accuracy of the survey layout or the construction work.

The level circuit to check the plan benchmarks shall be run the full length of the project.

B. Slope Staking:

Slope stakes shall be set at the catch points. The slope stake reference hubs shall be offset behind the slope stake a sufficient, set, consistent distance to prevent disturbance during construction. Slope stake referencing shall be approved by the Engineer.

Slope stakes shall reference the subgrade shoulder or toe of the back slope and shall be set at intervals consistent with the plans stations. Horizontal curves and vertical curves will require additional slope stakes set at intervals sufficient to maintain adequate grade and line control. Slope stake tolerances shall be ± 0.2 feet (60.0 mm) horizontal and ± 0.1 feet (30.0 mm) vertical. Slope stake reference hubs shall reference the subgrade shoulder and tolerances will be ± 0.2 feet (60.0 mm) horizontal and ± 0.05 feet (15.0 mm) vertical.

The Contractor shall retain the slope stakes and hub references until the grading work is completed and accepted by the Engineer.

C. Grade Staking:

The grade finishing stakes (blue tops) for grade elevations and horizontal alignment shall be set on the roadway centerline and at each shoulder at the top of the subgrade. Where additional lanes are to be constructed, additional blue tops shall be set at the extended shoulder distance at the additional lane edge.

Transverse distance between blue tops shall not exceed 20 feet (6 meters). Intermediate blue tops will be required and shall be approved by the Engineer when transverse distance exceeds this value.

The blue top grade stakes shall be set at station intervals consistent with the plans not to exceed 100 feet on tangents and 50 feet on horizontal or vertical curves (English unit plans) or 20 meters (metric unit plans). The horizontal tolerance is ± 0.2 feet (60 mm) and the vertical tolerance is ± 0.02 feet (6 mm).

The Contractor shall furnish stakes of sufficient length to provide a solid set in the ground. Half length lathe stakes or stake chasers shall be placed adjacent to or on

the blue top hubs for guards. Stakes not meeting these requirements shall be reset at no additional expense to the City.

The Contractor shall retain the shoulder blue tops and guards through placement of the gravel base course material.

When the contractor is required to set grade stakes at the top of the gravel base course surfacing material, the blue tops shall remain in place until the gravel base course surfacing material is finish graded and accepted by the engineer.

Paving hubs for Portland Cement Concrete paving shall be set at a maximum longitudinal distance of 25 feet (8 meters). Closer spacing which may be required by the paving contractor will be at no additional expense to the City. Horizontal and vertical tolerance is ± 0.02 feet (6 mm).

Grading, blue top and paving hub notes will become the property of the City.

D. Structure Staking:

Stake and reference bridges and box culverts to ensure adequate horizontal and vertical control of the substructure and superstructure components. Stake and reference the bridge chord or the bridge tangent. Stake and reference the centerline of each pier, bent, and abutment. Stake the centerline for pipe or box culverts in both transverse and longitudinal directions.

If retaining wall design is required as part of the construction, the wall designer must be provided with original ground profile data prior to beginning the design. The Contractor shall set adequate stakes for vertical and horizontal control during retaining wall construction.

Stakes for structures and retaining walls shall have a horizontal tolerance of ± 0.04 feet (12 mm) and a vertical tolerance of ± 0.02 feet (6 mm).

E. Re-establish Property and ROW Markers:

All property corners, ROW markers and bench marks shall be carefully referenced and replaced by a licensed land surveyor. Known property corners, ROW markers and bench marks are shown on the plans. Other monuments may exist within or adjacent to the project limits and shall be referenced as they are found and replaced as necessary at no expense to the City. Prior to construction, a licensed land surveyor shall verify existing property pins or lost property pins and record his findings for all possible property pin locations within the construction limits.

F. Miscellaneous Staking:

Miscellaneous staking shall include the following work:

- a. Final earthwork (or terrain data) cross sections at the same intervals, stations and plus stations as the original cross sections;
- b. Approach road/driveway staking;
- c. Topsoil measurement;
- d. Special ditch/drainage staking;
- e. Staking and/or measurement of sub-excavation, muck excavation, rock excavation, undercut excavation and dig-outs;
- f. Staking of signs, pavement markings, guardrail, curb and gutter, light poles, conduit, junction boxes and irrigation systems, and related items;
- g. ROW staking;
- h. Water and sanitary sewer mains and services including pipe, manholes, valves, bends, fittings and related items;
- i. Mark limits of removal items (trees, foundations, curb and gutter, sidewalk, etc.);
- j. Storm pipe culvert and storm sewer staking including drop inlets, manholes and related items.

Minor location and grade adjustments that are necessary to properly stake the pipe shall be approved by the Engineer prior to the pipe installation. Set reference stakes for the storm sewer inlet and outlet locations. Stake ditches and special inlet and outlet grades to ensure proper drainage.

The horizontal tolerance for water and sanitary sewer main and storm sewer staking is ± 0.05 feet (15 mm) and the vertical tolerance is ± 0.03 feet (9 mm).

201.4 METHOD OF MEASUREMENT

Staking shall be lump sum when shown as lump sum in the proposal. When staking is stated as an hourly item, the Contractor shall submit and certify a daily log of hours worked by each survey crew on the project. Removing and resetting Property Pins shall be per each when shown in the proposal. If not included in the proposal, removing and resetting Property Pins shall be considered incidental to the Construction Staking bid item and no separate measurement will be made. Verification of property pin locations will be considered incidental to the item for removing and resetting property pins and no separate measurement will be made.

201.5 BASIS OF PAYMENT

Staking will be paid at the lump sum unit price established in the bid proposal where such work is proposed as a lump sum item. Where such work is proposed as an hourly item, staking will be paid at the contract unit price per hour. When the number of hours is fixed in the bid proposal, final staking quantity will not exceed the contract quantity. Removing and resetting property pins will be paid at the per each unit price established in the bid proposal where such work is proposed as a per each item.. If not included in the proposal, removing and resetting Property Pins shall be considered incidental to the Construction Staking bid item and no separate payment will be made. Partial payment of lump sum unit price, when allowed, shall be made according to the following schedule:

Percentage of Contract Amount Completed (Excluding Construction Staking Itself)	Percentage of Construction Staking Paid
Five Percent (5%)	Twenty-Five Percent (25%)
Twenty Percent (20%)	Fifty Percent (50%)
Thirty-Five Percent (35%)	Sixty Percent (60%)
Fifty Percent (50%)	Seventy Percent (70%)
Seventy-Five Percent (75%)	Ninety Percent (90%)
One Hundred Percent (100%)	One Hundred Percent (100%)

END OF SECTION

SECTION 202

ENGINEERING FABRIC

202.1 DESCRIPTION

A. General:

This work shall consist of placement of engineering fabric material under drainage structures and storm sewer culverts, sub-grade stabilization under paving sections, in modular block retaining walls and other uses.

B. Related Work:

Section 14	Embankment
Section 64	Under-drains
Section 68	Bank and Channel Protection Rock Filled Wire Baskets
Section 69	Bank Protection Gabions
Section 109	Riprap and Slope Materials
Section 117	Aggregates for Granular Bases and Surfacing

202.2 MATERIALS

A. Engineering Geogrid Fabric Material:

Engineering fabric materials used as structural geogrid shall be integrally formed structural polypropylene geogrid or approved equal. The fabric shall be free of kinks, tears and excessive worn or abraded areas. The fabric shall be inert to commonly encountered chemicals and shall meet the following test requirements:

<u>TEST</u>	<u>TEST VALUE</u>
Polypropylene (ASTM D 4101)	98% Group 1, Class I, Grade 2
Dynamic Load Capacity at 2% Strain (GRI GG1)	300 LBS/FT MIN (Main Dimension) 445 LBS/FT MIN (Cross Dimension)
Mass Per Unit Area	6.4 oz/sy
Maximum Aperture Size	1.0 in. (MD) – 1.3 in. (XD)

B. Drainage Fabric Material:

Drainage fabric materials shall be a woven or non-woven fabric consisting of long chain polymeric filaments or yarns, such as polypropylene, polyethylene, polyester, polyamide, or polyvinyl chloride. The fabric shall be formed into a stable network

insuring that the filaments or yarns retain their relative position to each other. The fabric shall be inert to commonly encountered chemicals, shall be relatively inert to ultraviolet light, and shall meet the following test requirements:

<u>TEST</u>	<u>TEST VALUE</u>
Grab Tensile Strength (ASTM D 4632)	200 lbs.
Elongation (ASTM D 4632)	50 %
Mullen Burst Strength (ASTM D 3786)	350 PSI
Puncture Strength (ASTM D 3787)	90 lbs.
Equivalent Opening Size (EOS) (ASTM D 4751)	70 to 140 U.S. Std. Sieve

C. Certification:

Certification that the engineering fabric meets specification requirements shall be furnished to the Engineer prior to installation.

202.3 CONSTRUCTION REQUIREMENTS

- A. Installation of engineering geogrid fabric material shall be to the limits shown on the plans or as directed by the Engineer and shall be in general compliance with the manufacturer's recommendations for the type of usage required.

The bed for the placement of the fabric shall be prepared by smoothing the surface of the sub-grade to minimize ruts, ridges and depressions. The Engineer may elect to waive sub-grade compaction specifications, dependent upon the condition of the sub-grade at the time of placement.

The fabric shall be placed upon the prepared bed as directed by the Engineer. The fabric roll shall be unrolled oriented along the long axis. Additional rolls necessary to make the required width shall overlap preceding rolls. Overlap shall be a minimum of 1 foot. The Engineer may require additional overlap up to 3 feet, dependent upon the condition of the sub-grade prior to installation.

The fabric shall be placed so that subsequent cover material does not shove, wrinkle or distort the in place fabric. Overlapping sections of fabric shall be oriented accordingly. Fabric may be held in place with small, hand placed piles of cover material or by staples or stakes to keep the fabric in place. Care shall be taken to prevent damage to the unprotected fabric before, during and after installation. No vehicle traffic will be allowed on the unprotected fabric.

Cover material shall be limestone ledge-rock aggregate base course as specified in Section 117 herein, unless otherwise specified in the plans or as called for by the Engineer. Cover material shall be placed by back dumping on to the fabric from the truck, and dozing or pushing the cover material from covered area to uncovered areas, or by loader dumping from covered area on to uncovered areas. Minimum depth of cover placement shall be 6 inches or as directed by the Engineer, dependent upon sub-grade stability at time of placement. When cover material has reached sufficient depth to prevent excessive kneading of the underlying fabric by the gravel processing equipment, the gravel base course shall be smoothed and, at the direction of the Engineer, watered, processed and compacted.

- B. Installation of drainage fabric material shall be as shown on the plans or as directed by the Engineer and shall comply with the manufacturer's recommendations for the type of usage required.
- C. Repairs to fabric damaged by failure to take adequate care during construction shall be at the cost of the responsible party. Repair of damaged drainage fabric material shall require removal of damaged material to the limits of the damage and removal of any existing backfill atop the fabric to a minimum of 1 foot outside of the limits of damaged material. A patch of similar material shall be placed over the undamaged material to a minimum of 1 foot outside the damaged material and properly backfilled.

202.4 METHOD OF MEASUREMENT

- A. Measurement of engineering fabric and drainage fabric shall be to the nearest whole square yard of material placed, not counting overlap of successive courses of material.
- B. Measurement of and payment for cover material shall be in accordance with Section 117 herein, except where special cover material is called for. Measurement and payment of special cover material will be as specified in the Detailed Specifications.

202.5 BASIS OF PAYMENT

- A. Engineering geogrid fabric material will be paid for at the Contract unit price per square yard. This price will be full compensation for preparation of the fabric bed, placing the fabric, and for labor, tools, equipment, fabric material, and incidentals necessary to complete the work as shown on the plans and as directed by the Engineer.
- B. Drainage fabric will be paid for at the contract unit price per square yard. This price will be full compensation for preparation of the fabric bed and for labor, tools, equipment, fabric material and incidentals necessary to complete the work as shown on the plans and as directed by the Engineer. If there is no bid item for drainage fabric, payment will be considered incidental work.

- C. Repairs to fabric damaged by failure to take adequate care during construction shall be at the cost of the responsible party.

END OF SECTION