

**CITY OF LANDER  
STANDARDS AND SPECIFICATIONS**



CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 201  
TRENCH EXCAVATION, BACKFILL  
AND RESTORATION  
FOR UNDERGROUND CITY AND  
PRIVATE UTILITIES

**SECTION 201  
TRENCH EXCAVATION, BACKFILL AND RESTORATION  
FOR UNDERGROUND CITY AND PRIVATE UTILITIES**

**SECTION 201.01 - GENERAL**

All excavation, BACKFILL and resurfacing for underground City and private utility construction within the City of Lander street and easement system or for future acceptance into the City of Lander street and easement system shall be installed in accordance with these specifications. Private utilities are exempt from the pipe bedding requirement or these specifications and have their own specifications for bedding of their particular utility.

**SECTION 201.02 - ENGINEERING PLANS**

Excavation, backfill and resurfacing for City and private utilities shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City Engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 201.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded General Utility Contractor. A permit shall be secured by the Contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City Engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City Engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 201.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 201.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or material for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such

hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City Engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four hours and complete such work within twelve hours of said notification by telephone. If repairs are not started or completed with the above time limits, the City at its option may have such repair made and invoice the contractor for the actual cost of repair.

#### **SECTION 201.06 - DESCRIPTION**

This section covers excavation, trenching and backfilling for pipelines, utility cables and appurtenances, complete. This item shall consist of all necessary clearing, grubbing and site preparation; removal of all material of whatever description that may be encountered; removal and disposal of debris; all necessary bracing, shoring and protection; pumping and dewatering as necessary; all backfill, preparation of subgrades; and final grading, dressing, surface restoration and cleanup of the site.

#### **SECTION 201.07 - STRIPPING**

When crossing existing or prospective cultivated areas, gravel streets or other developed surfaces, the Contractor shall strip the cover material to full depth at the existing surfacing. This surfacing shall be stockpiled and placed back over the trench after backfilling to the extent that it is acceptable and usable for that purpose. Topsoil shall be moved to full depth of the topsoil, or to a maximum depth of 12 inches, whichever is less.

All established lawn areas cut by the trench or damaged during the course of the work shall be restored to condition comparable to its surrounding area and to the complete satisfaction of the engineer.

#### **SECTION 201.08 - TRENCH EXCAVATION**

- A. General - All excavation, trenching and shoring and the up line, shall be performed in a manner that meets with the OSHA Department of Labor, Safety and Health Regulations for Construction.

When necessary to minimize sliding or caving of the trench, it will be permissible to slope the banks from the surface to an elevation 12 inches above the top of the bells, flanges or collars, trench banks below said elevation shall be maintained in a vertical plane until the pipe has been bedded and backfilled to an elevation of 12 inches above the pipe barrel.

Crossings under sidewalks or curbs may be made by tunneling only if approved by

Engineer. If the contractor elects to remove a portion of the sidewalk or curb, he must use a concrete saw for making neat joints corresponding to existing joints, compact the backfill as specified and pour a new concrete sidewalk or curb section.

During excavation, materials suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. Excavated material shall be piled on one side of the trench only, to permit ready access to existing fire alarm boxes, fire hydrants, valves, manholes and other appurtenances. Surface drainage of adjoining areas shall be unobstructed.

All excavated materials not required or suitable for backfill shall be removed from the site as directed by the Engineer.

Grading shall be done as may be necessary to prevent surface water from flowing into excavations and any other water accumulating therein shall be promptly removed. Under no circumstances shall water be permitted to rise in unbackfilled trenches until after the pipe has been placed, tested and covered with backfill. Any pipe having its alignment or grade changed as a result of a flooded trench shall be re-laid at no additional cost to the owner.

The bottom of the trenches shall be accurately graded to the line and grade shown on the drawings. Bedding material shall provide uniform bearing and support for each section of the pipe at every point along its entire length. Bell holes and depressions for joints shall be dug after the trench bedding has been graded, and shall be only of such length, depth and width as required for properly making the particular type joint. Unauthorized overdepths shall be backfilled with bedding material at the Contractor's expense.

There will be no differentiation between common and rock trench excavation, except when listed as separate items on the bid proposal or bid form. Excavation shall include the removal and subsequent handling of all earth, gravel, rock or other material encountered regardless of the type, character, composition or condition of the material.

B. Trench Dimensions - Trench dimensions shall be as specified below:

- (1) Width - The width of the trench shall be such to provide adequate working room for men to install and join the pipe in the specified manner. The width of the trench shall be adequate in width to allow proper compactive effort along both sides of the pipe.
- (2) Depth of Trench - Trench depth shall be as required for the invert grade or pipe bury shown on the plans. Care shall be taken not to excavate below the required depth.

When soft or unstable material or rock is encountered at the subgrade which will

not uniformly support the pipe, such material shall be excavated to an additional depth as directed by the Engineer and backfilled with Type 2 Bedding Material.

- C. Blasting - Blasting for excavation will be permitted only after securing the approval of the engineer and the hours of blasting will be fixed by the engineer. The contractor shall use the utmost care to protect life and property. All explosives shall be safely and securely stored in compliance with local laws and ordinances and all such storage places shall be clearly marked "Dangerous Explosives". No explosives shall be left unprotected where they could endanger persons or property.

When blasting rock in trenches, the contractor shall cover the area to be shot with earth backfill or approved blasting mats that will prevent the scattering of rock fragments outside the excavation. Prior to blasting, the contractor shall station men and provide signals of danger in suitable places to warn people and stop vehicles. The contractor will be responsible for all damage to property and injury to person resulting from blasting or accidental explosions that may occur in connection with its use of explosives.

The contractor shall furnish the following information to the owner and engineer prior to commencing blasting operations: Name of his powder man, powder man's experience, type of shot, type of explosives and detonator being used, proof of insurance covering liability for such operation, traffic control plans and planned procedures for protection of the public.

The contractor's blasting procedures shall conform to federal, state and local ordinances. The contractor shall acquire all required permits prior to the start of blasting.

- D. Equipment - The use of trench digging machinery will be permitted except in places where its operation will cause damage to existing structures or features; in which case hand methods shall be employed.

Any equipment operating on tracks, which is to be used on pavement, shall be equipped with suitable pads to prevent damage to the pavement. Backhoes shall be equipped with street pads on the outrigger arms. All pavement damage during construction by the contractor's equipment shall be restored to its original condition by the contractor. No compensation will be allowed for pavement replacement other than as specified elsewhere.

- E. Dewatering - Where ground water is encountered in excavation, it shall be removed to avoid interfering with pipe laying and other construction operations. The cost of dewatering operation will not be paid for as a separate item, but shall be merged with and considered a part of the excavation cost.

- F. Shoring, Sheeting and Bracing - The contractor shall do all shoring, bracing, tight sheeting required to prevent caving and to protect his workmen, in accordance with

Occupational Safety and Health Regulation Requirements and to protect adjacent property and structures. No extra payment shall be made for these items.

- G. Excavation for Appurtenances - Excavation for manholes, hydrants, structures and other appurtenances shall be sufficient to leave clearance adequate for proper compactive effort on all sides. The depth, provisions for removing water and other applicable portions of these specifications shall apply to excavation for appurtenances.

#### **SECTION 201.09 - TRENCH BACKFILL**

- A. Excavation - All trenches shall be backfilled immediately after grade, alignment and jointing of the pipe has been inspected and approved by the engineer. Leakage tests, pressure tests or tests for alignment and grade shall be performed after backfill. If any test fails, the contractor shall be responsible for work required to correct the defects at no additional cost to the owner.
- B. Pipe Bedding Material - Type I bedding material around and to twelve (12) inches over the pipe shall consist of select earth, sand or fine gravel, free from clods, lumps of frozen material or stones larger than one and a half (1 ½) inches in their maximum dimension. Where wet or otherwise unstable conditions exist, the material in this zone shall be free draining, non-plastic material. Where suitable material is available in the material excavated from the trench, the contractor may procure the select material by screening, sifting or manually sorting the material removed from the trench. The rock shall be removed from the project and disposed of by the contractor at his expense.

Type 2 pipe bedding shall be required where specified for flexible pipe and for over excavated foundations in wet and unstable trenches. Where required for pipe bedding, the material shall be placed from four (4) inches below to a point twelve (12) inches above the top of the pipe. The bedding material shall consist of well-graded sand or sand gravel mixtures having a maximum size of 1 ½ inches. Poorly graded gravel with a maximum size of ¾ inches may be used at the direction of the engineer.

Bedding material under and around the pipe to twelve (12) inches above the top of the pipe shall be distributed by hand in maximum layers of six (6) inches and thoroughly compacted by tamping. Special care shall be taken to assure complete compaction under the haunches of the pipe.

Backfill material shall be placed in the trench for its full width on each side simultaneously. Compaction of pipe bedding shall be in accordance with the pipe manufacturer's recommendations.

Water settling of this portion of the trench will not be allowed and the addition of water shall be limited to that required for optimum moisture for maximum compaction of the

material.

1. General - After the select pipe or utility cable bedding material has been placed and compacted as specified above, the remainder of the trench backfilling shall be done. All backfill material shall be free from cinders, ashes, refuse, organic and frozen material, boulders or other materials that are unsuitable. From one (1) foot above the top of pipe to six inches (6") below the ground surface or to the subgrade elevation for streets or paved surfaces, material containing stones up to eight inches (8") in the greatest dimension may be used.

Trench backfill from the top of the pipe or utility cable bedding material to ground surface or to the subgrade of street surfacing is separated into three classifications. Type A trench backfill refers to compacted backfill in paved streets to four feet (4') behind the curb and other paved areas, while type B backfill is designated for alleys and unimproved streets. Type C backfill is designated for fields, borrow pits and other unsurfaced areas where special compaction of the trench backfill is not required. Locations of the types of backfill required shall be as shown on the plans or in the special provisions.

2. Type A Trench Backfill - Materials used for backfill shall be carefully deposited in layers suitable to the equipment used for compaction, wetted to optimum moisture content and then compacted to not less than 90% of maximum density to within six inches (6") of the finished subgrade and 95% of maximum density for the top six inches (6") of backfill, subgrade, when determined in accordance with the requirements of AASHTO T-99 standard method of test for moisture density relations of soils.

Compaction by jetting and vibrating or wheelrolling will only be permitted by approval of the engineer. Whenever the trenches have not been properly compacted, or if settlement occurs, they shall be reopened to the depth required for proper compaction and refilled and recompacted. See section five (5) on compaction by jetting and vibrating or wheelrolling.

The contractor shall provide excavation equipment to dig compaction test holes through each layer of backfill where the layers exceed one foot (1') in depth as directed by the engineer. Should the test fail, the deficiencies shall be corrected by the contractor at his expense.

3. Type B Trench Backfill - Materials used for backfill shall be deposited in layers suitable to the equipment used for compaction and compacted to 85% of maximum density, when determined in accordance with the requirements of ASSHTO T-99 or equal to the density of the surrounding material, whichever is greater.

For graveled streets and alleys the backfill shall be completed by blading the



stripped gravel back over the trench.

4. Type C Trench Backfill - Materials used for Type C Trench Backfill shall not require special compaction. However, the material shall be placed in layers to achieve a density equal to the density of the surrounding material.

The contractor may be required to mound excess earth over the top of the trench so that a depression will not be formed after the trench settles. In cultivated areas, the stripped topsoil shall be placed uniformly over the backfilled trench. The topsoil shall not be compacted but shall be graded to provide a smooth surface conforming to the adjoining ground surfaces.

5. Compaction by Jetting and Vibrating or Wheel Rolling - Consolidation of backfill by jetting and vibrating will only be allowed when the backfill material has a plastic index of 6 or less (cohesionless soils) and when consolidation is obtained in the following manner:

Backfill shall be loosely placed over the consolidated bedding to within six inches of finish grade and allowed to set for a period of five days, providing sufficient time for the concrete encasement and mortars to become hard enough to withstand the backfill consolidation.

The loose backfill shall then be consolidated by water jetting and vibration. Water, at a minimum pressure of 40 PSI, shall be injected into the backfill through a rigid pipe nozzle to within one foot of the top of the pipe. If water is not available from a distribution system, the Contractor shall equip a supply tank, or other water source, with a suitable pressure pump. Vibrators shall be of immersion type of adequate power to consolidate the mass and of sufficient length to reach within one foot of the top of the pipe. A vibrating ram mounted on a backhoe may also be used for compaction.

Care shall be taken to use only sufficient water at each jetting point to insure permeation of the backfill and proper consolidation and not result in surface saturation. The vibrator shall not be removed from the mass until after the jet is removed. The jetting pipe nozzle and the vibrator shall be inserted in the backfill at sufficiently close intervals along the trench to insure that uniform consolidation will result.

After the jetted and vibrated backfill has settled and the surface is dry enough to be stable, the balance of the trench shall be filled in eight inch loose lifts, each lift being thoroughly compacted at the proper moisture content, to the relative compaction specified in paragraphs two or three.

If wheel rolling rather than vibrating is used for compaction, then as soon as the surface is dry enough to be stable (from one to one and a half days), thoroughly

wheelroll the backfill. The balance of the trench shall be filled in eight inch loose lifts, each lift being thoroughly compacted, at the proper moisture content, to the relative compaction specified in paragraphs two or three.

6. Compacted Control Tests - Test for laboratory and field densities shall be performed in accordance with Section 601.10, COMPACTION CONTROL TESTS.
- D. Backfilling for Appurtenances - Backfill around appurtenances shall be deposited in such a manner as not to disturb the appurtenance from its proper alignment and compacted to the finished grade. Backfill material, compaction and backfill procedures shall conform to the requirements of the related Type A or Type B backfill as specified for trenches.
- E. Backfill Above Original Ground For Minimum Cover Requirements - Where shown on the plans, the contractor shall provide embankment over the pipe above the original ground surface to a height which will satisfy the minimum depth of cover requirements. Such embankment shall be constructed to the cross section shown on the plans. No additional compensation will be paid for embankment unless shown as a specific item on the proposal.

#### **SECTION 201.10 - CONTRACTOR'S SAFETY RESPONSIBILITIES**

The contractor shall be responsible for enforcing safety and maintaining safe working conditions in all trenching, shoring and blasting operations to conform to Wyoming Occupational Health and Safety Rules and Regulations for Construction.

The contractor shall employ qualified, properly trained personnel to design shoring, perform safety inspections of the trenches and supervise the handling of explosives and other operations involving safety procedures, as prescribed by Wyoming Occupational Health and Safety Commission.

#### **SECTION 201.11 - TRAFFIC CONTROL AND WARNING DEVICES**

The contractor shall construct the project in such a manner as to minimize the interruption of the use of roads, highways or streets involved and shall provide for emergency runs and fire hydrant access at all times.

The contractor is responsible for providing adequate barricades of high visibility design, flares, lanterns, signs, flagmen and prewarning devices to alert the public, motorists and pedestrians of hazardous conditions in accordance with the latest issue of the manual on Uniform Traffic Control Devices for Streets and Highways published by the Department of Transportation.

#### **SECTION 201.12 - PROTECTION OF EXISTING PROPERTIES**

- A. General - Prior to beginning construction, the contractor must fulfill and meet the requirements of Wyoming Statutes 37-12-301 through 37-12-304 relating to public utilities; providing definitions; providing the notice of intended excavation be given to public utilities with underground facilities located in the area of proposed excavation; and providing for exceptions. See attached copy of Title 37, Public Utilities.

Existing utilities which will intersect with the new pipelines or structures will be relocated by the owner or by the contractor when the relocation is authorized in writing. In the event the contractor is authorized to relocate the utilities, payment will be made in accordance with the General Conditions.

Existing water or sewer services from the mains to private property which interfere with trenching operations may be cut and replaced at the contractor's option and expense. The use of such services shall in no case be interrupted for more than four (4) hours, unless specifically permitted in writing by the user.

Existing water mains and water services shall be protected at all times during construction operations.

- B. Privately Owned Utilities - Gas mains, underground electrical and telephone cables, telephone poles, light poles, etc., required to be moved to make way for new construction will be moved by others.
- C. Exploratory Excavation - Location of buried utilities that might interfere with alignment or grade shall be verified by exploratory excavation prior to construction. If any existing utility interferes with the work in either alignment or grade and has to be moved, such work shall be done by the contractor and adjustment in payment will be made at a price agreed upon before the work is started.
- D. Maintenance of Flows - Adequate provisions shall be made for maintaining the flow of sewers, drains and water courses encountered during construction. Culverts, ditches, fences, crosswalks and structures which are disturbed by this construction shall be satisfactorily restored to their original condition upon completion of the work.
- E. Structures - The contractor shall exercise every precaution to prevent damage to existing buildings or structures in the vicinity of his work. In the event of such damages, he shall repair them to the satisfaction of the owner of the damaged structure and at no cost to the owner.
- F. Overhead Utilities - The contractor shall use extreme caution to avoid a conflict, contact or damage to overhead utilities, such as power lines, street lights, telephone lines, television lines, poles or other appurtenances during the course of construction of this project.

- G. Pavement Removal - Where trench excavation or structure excavation requires the removal of curb and gutter, concrete sidewalks or asphaltic or concrete pavement, the pavement or concrete shall be cut in a straight line parallel to the edge of the excavation by use of a spadebitted air hammer, concrete saw or similar approved equipment to obtain a straight, square clean break. Pavement cuts shall be two (2) feet wider than the actual trench opening and centered over such trench.
- H. Survey Markers and Monuments - The contractor shall use every care and precaution to protect and not disturb any survey marker or monuments, such as those that might be located at lot or block corners, property line, intersection of street monuments or addition line demarcation. Such protection shall include marking with flagged high lath and close supervision. NO monuments shall be disturbed without prior approval of the owner and engineer. Any survey marker or monument that is disturbed or destroyed by the contractor without approval during the construction of this project shall be replaced at no cost to the owner by a licensed land surveyor.

### **SECTION 201.13 - SURFACE RESTORATION**

- A. Temporary Resurfacing - During construction the trench backfill shall be topped out with not less than nine inches (9") of WHD grading W crushed base course and maintained free of chuck holes, ruts and loose rock, by patrolling until asphalt surfacing is in place. During cold weather the contractor shall install temporary bituminous resurfacing two inches (2") thick at locations determined by the engineer whenever excavation is made through pavement, sidewalk or driveways. In sidewalk areas the temporary bituminous resurfacing shall be at least one inch (1") thick; in all other areas it shall be at least two inches (2") thick. At major intersections and other critical locations, a greater thickness may be ordered. Temporary resurfacing shall be placed as soon as the condition of the backfill is suitable to receive it and shall remain in place until the condition of the backfill is suitable for permanent resurfacing.

The bituminous mixture used for temporary trench resurfacing may be furnished from stockpiles or directly from the plant mixer and may be laid cold, at the option of the contractor. The resurfacing shall be placed, rolled, maintained and removed and disposed of by the contractor.

- B. Permanent Resurfacing - Unless otherwise specified on the plans or in the special provisions, all surface improvements damaged or removed as a result of the contractor's operations shall be reconstructed by the contractor to the same dimensions, except for pavement thickness and with the same type materials used in the original work. Trench resurfacing shall be the depth of adjacent asphalt or three inches (3"), whichever is greater, placed in two layers. When hot mix pavement material is not available, cold mix pavement material may be used, but shall have a minimum depth of four inches (4"), placed in two equal layers. See Standard Drawing No. 201.02.

Surfaces for trenches in gravel streets or alleys shall be restored to their original shape and the surfacing material shall be of equal quality and equal thickness to that of the original surface. Gravel surfacing material shall be approved by the engineer. Care shall be taken to not contaminate existing gravel surfaces outside the trench area.

Subgrade for trench resurfacing shall be restored to that existing prior to the excavation and shall be placed in a manner that will permit the restoration of the surface to condition equivalent to that in which it was prior to excavation.

Backfill of the final six inches (6") below the bottom of existing asphalt shall consist of WHD grading W crushed base as specified in Section 607A.04, AGGREGATE FOR UNTREATED SUB-BASE AND BASE. The base course shall be brought to within one inch (1") below the bottom of the existing asphalt and compacted to not less than 95% of the maximum density when determined in accordance with the requirements of AASHTO T-99.

#### **SECTION 201.14 - CLEAN UP**

As work progresses, that portion of the work completed shall be cleared of debris and brought to the finished grade. Upon completion of the work, the entire site shall be cleared of all debris and ground surfaces shall be finished to smooth, uniform slopes and shall present a neat and workmanlike appearance. All rocks brought to the ground surface by excavation or backfilling operations shall be removed.

#### **SECTION 201.15 - TIME OF OPEN TRENCHES**

The contractor will be required to conduct his work so that trenches will remain open a minimum possible time.

No trench excavation shall begin until approved compaction equipment is at the site where the excavation is to take place. All backfill and compacting shall be completed in all trenching and structural excavation within a maximum distance of 500 feet behind the end of newly installed pipe and the maximum distance between the newly installed pipe and the excavator shall be 200 feet. For each work group consisting of trench excavator, a pipe laying crew and a backfilling and compacting crew, the maximum allowable open ditch at any time will be 700 feet. The maximum distance behind the end of the new pipe shall be 1,500 feet for gravel replacement or for base placement or pavement replacement.

Certain conditions, as provided in the special provisions of the specifications, may necessitate the closing of certain sections of trench prior to daily, weekend or holiday shutdown.

Private utility trenches, on utility easements within subdivisions are exempt from the requirements of this subsection 201.15.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 301  
WATER MAINS**

## **SECTION 301 WATER MAINS**

### **SECTION 301.01 - GENERAL**

All water main construction within the City of Lander water system or for future acceptance into the City of Lander water system shall be installed in accordance with these specifications.

### **SECTION 301.02 - ENGINEERING PLANS**

Water mains shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City engineer. Plans shall conform with the City of Lander minimum design standards.

### **SECTION 301.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general utility contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The city engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

### **SECTION 301.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

### **SECTION 301.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work

within four hours and complete such work within twelve hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City, at its option, may have such repairs made and invoice the contractor for the actual cost of repair.

### **SECTION 301.06 - DESCRIPTION**

- A. General - This section covers construction of water mains, including fittings and other appurtenances normally used for water supply and distribution systems. This item shall consist of furnishing and installing pipe and fittings, constructing of thrust blocking, testing, cleaning and disinfection of mains and other related work.
- B. Replacement of Existing Water Mains - This work will be accomplished with as little disruption of water service and traffic as possible. All new replacement water mains will be laid on the same location and grade as the existing mains. Salvage pipe and fittings will be returned to the water department yard.

Temporary water service to the effected residences along the main will be provided by the contractor, by means of a temporary header pipe or hoses, from uneffected fire hydrants or residences. A back flow preventer or check valve will be installed between the fire hydrant and the temporary header pipe. Each section of completed main shall be pressure tested, disinfected and flushed, according to these specifications, before being returned to service.

Individual driveways, shall be reopened, with a temporary gravel surface, at the end of each working day. Restoration of each street or alley shall be completed within two weeks after completion of the pipe laying in that particular section.

### **SECTION 301.07 - MATERIALS**

- A. Pipe - Pipe used in water main construction shall be as called out in the special provisions and shall be in accordance with the following specifications:

- 1. Ductile Iron Pipe - Ductile iron pipe shall conform to the provisions of AWWA Specifications C-151. Wall thickness shall be class 52.

Pipe joints shall be mechanical joint or "Push-on" joints conforming to AWWA Specification C-111.

The interior of the pipe shall have a cement mortar lining conforming to the requirements of AWWA Specification C-104. The outside surface of pipe designed for underground service shall receive a bituminous coal tar base coating approximately one (1) mil thick.

The required minimum depth of cover between the top of barrel and the finished



grade of the street is six and one half (6.5) feet.

Bedding of ductile iron pipe shall conform to type 1 pipe bedding and placement under applicable portions of Section 201.09 Trench Backfill.

2. Polyvinyl Chloride (PVC) Pressure Pipe - PVC pipe for the water mains shall meet the requirements of AWWA Specification C-900 "Polyvinyl Chloride Pressure Pipe" made to ductile iron O.D.'s for "Push-on" joints. Pipe class shall be 150 PSI pressure class and SDR-18.

Pipe joints shall be mechanical joint or single gasket, unibell, push on type joint.

The required minimum depth of cover between the top of barrel and the finished grade of the street six and one half (6.5) feet.

Bedding of (PVC) pressure pipe shall conform to Type 1 pipe bedding and placement under applicable portions of Section 201.09 Trench Backfill. Double strap, bronze service clamps, will be required for all installation of service corporations on PVC water mains.

3. Casing Pipe - Pipe used to case waterline - sewer line crossings shall be (PVC) DR-26, with a minimum diameter of 1.25 times O.D. of carrier pipe.
4. Any other pipe acceptable for use on the projects shall be outlined in the special provisions.

B. Fittings - Fittings used for water mains shall be cast iron or ductile iron.

1. Cast Iron and Ductile Iron Fittings - Class 250 conforming to AWWA Specifications C-110, gray-iron and ductile iron fittings for water and other liquids. Joints for ductile iron pipe and PVC pipe shall be mechanical joint or "Push-on" joints conforming to AWWA Specification C-111. Joints for PVC pipe shall be ring tight. The interior of the fitting shall have a cement mortar lining conforming to AWWA Specification C-104. The outside surface of the fitting shall receive a bituminous coal tar base coating approximately one (1) mil thick. Couplings for making connections to existing pipelines and fire hydrants shall be Smith-Blair Type 413, Type 433, Type 435, or Dresser Style 62, Style 153, Style 162, or an approved equal. Special fittings shall be in accordance with the plans and special provisions.

C. Certification by Manufacturer - When required by the Engineer, the Contractor shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe and fittings comply with the applicable specifications.

All pipe shall be clearly marked with type, class and/or thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

### **SECTION 301.08 - TRENCH EXCAVATION AND BACKFILL FOR WATERMAINS**

Trench excavation and backfill shall include all excavation, backfilling, disposal of surplus and unsuitable material and all other work incidental to the construction of trenches, including any excavation which may be required for valves, fittings, hydrants, thrust blocks or other structures forming a part of the pipeline.

Work performed under this section shall be in conformance with construction specifications, Section 201, "Trench Excavation, Backfill and Restoration for Underground City and Private Utilities", for the City of Lander Standards and Specifications.

### **SECTION 301.09 - PIPE INSTALLATION FOR WATER MAINS**

- A. General - Pipe shall be installed in accordance with the manufacturer's recommendations for installing the type of pipe used unless modified or changed on the special provisions. The contractor shall provide all tools and equipment including any special tools designed for installing each particular type of pipe used.
- B. Dewatering of Trench - Where water is encountered in the trench, it shall be removed during pipelaying operations and the trench so maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe.
- C. Responsibility for Material - The contractor shall be responsible for all material furnished by him and shall replace at his own expense, all such material found defective in manufacture or damage in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered damaged or defective prior to the final acceptance of the work or during the guarantee period.

The contractor shall be responsible for the safe and proper storage of material furnished by him or to him and accepted by him and intended for the work, until it has been incorporated in the completed project. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.

- D. Handling of Pipe - All pipe furnished by the contractor shall be delivered and distributed at the site by the contractor. Pipe, fittings, specials, valves and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such material be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite

or near the place where it is to be laid in the trench.

Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the contractor at his expense in a manner satisfactory to the engineer.

- E. Laying of Pipe - Before installation, the pipe and pipe coating shall be inspected for defects. Any damage to pipe coating shall be repaired with the same materials used for the original coating before laying the pipe.

All pipe shall be laid and maintained to the required lines and grades with fittings and valves at the required locations.

Grade and alignment on ungraded streets will be given from hubs set parallel to the line of the pipe and on graded streets the grade and alignment shall be taken from established points on the existing curbs or sidewalks, when directed by the engineer. Trenches for the pipe shall be opened in accordance with the lines and grades given or to the standard depth or cover provided in the Section 301.07. The contractor shall transfer lines and grades to the pipe from hubs set by the Engineer or from existing concrete curbs or sidewalks as an incidental part of this work.

Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the plan is required, the engineer shall have the authority to change the plans and order a deviation from the line and grade or arrange with the owners of the structures for the removal, relocation and reconstruction of the obstructions. If the change in plans results in a change on the amount of work by the contractor, such altered work shall be done on the basis of payment to the contractor for extra work or credit to the owner for less work.

Proper implements, tools and facilities satisfactory to the engineer shall be provided and used by the contractor for the safe and convenient prosecution of the work. All pipe, fittings and valves shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipe materials and protective coating and linings. Under no circumstances shall materials be dropped or dumped into the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. All pipe shall be visibly inspected and all foreign matter or dirt shall be removed from the interior and ends of pipe before they are lowered into position in the trench. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a water-tight plug or other means approved by the engineer.

Long radius curves, either horizontal or vertical, may be laid with standard pipe by

deflections at the joints. If the pipe is shown curved on the plans and no special fittings are shown, the contractor can assume that the curves can be made by deflection of the joints with standard lengths of pipe. If shorter lengths are required, the plan will indicate maximum lengths that can be used.

Where field conditions require deflection or curves not anticipated by the plans, the engineer will determine the methods to be used. No additional payment will be made for laying pipe on curves as shown on the plans, nor for field changes involving standard lengths of pipe deflected at joints. When fittings not shown on the plans are required to meet field conditions, additional payment will be made for fittings.

Maximum deflections at pipe joints for various types of pipe shall not exceed the applicable material and joint specifications of AWWA nor shall they exceed the recommendations of the pipe manufacturer. When rubber gasketed pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wide on curves for this purpose.

Reaction or thrust blocking shall be applied at all tees, plugs, caps and at bends deflecting  $22\frac{1}{2}^{\circ}$  or more, or movement shall be prevented by attaching suitable metal rods or straps as approved by the engineer. Reaction blocking shall be concrete having a compressive strength of not less than 2,000 pounds per square inch at 28 days. Blocking shall be placed between solid ground and the fittings to be anchored; the area of bearing on the pipe and on the ground shall be as shown on Standard Drawing 303-01. The blocking shall be so placed that the pipe and fitting joints will be accessible for repair.

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or coating and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of any oxyacetylene torch shall not be allowed.

## **SECTION 301.10 - PIPE JOINTING**

- A. Rubber Gasket "Push-On" Joints - Jointing of pipe and fittings with a rubber gasket "push-on" joint shall be as recommended by the manufacturer. The rubber gasket and gasket seat inside the bell shall be wiped clean with a cloth. A thin film of lubricant, furnished with the pipe, shall be applied to the inside surface of the gasket. The plain end of the adjoining pipe shall be wiped clean and inserted into the bell a sufficient distance to make contact with the gasket. The plain end shall then be forced "home" by the use of a crow bar, fork tool or jack assembly. All "push-on" joint ductile iron pipe shall be connected with three (3) driven brass wedges, for electrical conductivity.
- B. Mechanical Joints - The inside of the bell and the outside of the spigot of the mechanical joint fittings shall be brushed thoroughly with a wire brush to remove all loose rust or

other foreign material just prior to assembly . The cleaned surfaces shall be brushed with soapy water just prior to slipping the gasket over the spigot end and into the bell.

The spigot end of the pipe or fitting shall be accurately centered in the bell before jointing is begun. After the gasket is in place the gland shall be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. Bolts shall be partially tightened alternately around the socket maintaining approximately equal tension until the final tension is reached.

The normal range of bolt torques to be applied to the cast iron bolts in the joints shall be as follows:

BOLT SIZE (INCH)	RANGE OF TORQUE (FT. LB.)
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1 1/4	90 - 120

The above torque loads may be applied with torque measuring or indicating wrenches, or they may be applied using regular socket wrenches and checked to torque wrenches.

In effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Over stressing of bolts to compensate for poor installation practice with not be permitted.

- C. Connection to Existing Mains - All connections to water mains in use shall be made by the contractor unless otherwise provided in the special provisions. The contractor shall furnish the special as shown on the plans and all other material required. He shall make all necessary excavations to assure gradual transition between the new and existing water main and he shall perform all necessary backfilling.

Where the connection of new work to old requires interruption of service and notification of customers affected, the superintendent of the utility, the engineer and the contractor shall mutually agree upon a date for connections which will allow ample time to assemble labor and materials and to notify all customers affected.

**SECTION 301.11 - PRESSURE TESTS** - Test pressure shall be 150  $\pm$ 5 PSI. At points where pressure reaction and movement may occur, the pipe shall be properly blocked or braced. Where

permanent blocking is not required, the contractor shall furnish and install temporary blocking during the test period. While under test pressure, the installation shall be carefully examined for defective material replaced by the contractor. The duration of each pressure test will be two hours unless otherwise specified by the engineer. Leakage during pressure test shall not exceed that specified by the appropriate AWWA specifications for the size and type of pipe being used, but in no case shall leakage exceed 13 gallons/inch diameter/mile/day. The contractor shall furnish all labor, equipment and material to make the test.

- A. General - It is the intent of this standard to present essential procedures for disinfecting new and repaired water mains.
- B. Basic Procedure - The basic procedure comprises:
  - (1) Preventing contaminating materials from entering the water mains during construction or repair and removing by flushing materials that may have entered the water main.
  - (2) Disinfecting any residual contamination that may remain.
  - (3) Determining the bacteriologic quality by laboratory test after disinfection.
- C. Supplementary Information to Be Supplied by Engineer - When the disinfecting of water mains is to be under a separate contract or as part of a contract for installing the mains, the engineer shall provide the following items of specific information in his supplementary specifications:
  - (1) Standard of reference; that is--AWWA C-601-81
  - (2) Places where flushing may be done, rates of flushing and location of drainage facilities (Item E, Preliminary Flushing, and Table 1).
  - (3) Form of chlorine to be used (Item F, Form of Chlorine for Disinfection) and method of application (Item G, Methods of Chlorine Application).
  - (4) The number of frequency of samples for bacteriologic tests (Item I, Bacteriologic Tests).
  - (5) Method of taking samples (Item I, Bacteriologic Tests, Paragraph b).
  - (6) Disposal of chlorinated water shall meet requirements of the Water Quality Division of the Wyoming Department of Environmental Quality.
- D. Preventive Measures During Construction
  - (1) Keeping Pipe Clean and Dry - Precautions shall be taken to protect pipe interior,

fittings and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrances of foreign material. When pipelaying is not in progress, as, for example, at the close of the day's work, all openings in the pipeline shall be closed by water-tight plugs. Joints of all pipe in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

NOTE: Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipelaying, the less the contamination.

If dirt that, in the opinion of the owner's engineer or job superintendent, will not be removed by the flushing operation (Item E, Preliminary Flushing) enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a one percent (1%) hypochlorite disinfection solution.

- (2) Packing Materials and Joints - No contaminated material or any material capable of supporting prolific growth of micro-organism shall be used for sealing joints. Packing material shall be handled in such a manner as to avoid contamination.

Yarning or packing material for cast iron pipe shall consist of molded or tubular rubber rings, rope of asbestos or treated paper. Materials such as jute or hemp shall not be used.

The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in enclosed containers and shall be kept clean.

- E. Preliminary Flushing - The main shall be flushed prior to disinfection except when the tables method is used. (Item G, Methods of Chlorine Application, Paragraph c). The sites and velocities of flushing shall be as specified in the supplemental specifications.

NOTE 1: The flushing velocity shall be not less than 2.5 ft/sec. The rate of flow required to produce this velocity in various diameters is shown in Table 1. No site for flushing should be chosen unless it has been determined that drainage is adequate at that site.

NOTE 2: Flushing is no substitute or preventive measure taken before and during pipelaying (Item D, Preventive Measures During construction). Certain contaminants, especially in caked deposits, resist flushing at any velocity. Furthermore, with diameters of 16 inches or more, even the minimum flushing velocity of 2.5 ft/sec. is sometimes difficult to achieve.

TABLE I

Required Openings to Flush Pipelines* (40 PSI Residual Pressure)				
PIPE SIZE IN.	FLOW REQUIRED TO PRODUCE 2.5 VELOCITY GPM	ORIFICE SIZE IN.	HYDRANT OUTLET NOZZLES	
			NUMBER	SIZE IN.
4	100	15/16	1	2 1/2
6	220	1 3/8	1	2 1/2
8	390	1 7/8	1	2 1/2
10	610	2 5/16	1	2 1/2
12	880	2 13/16	1	2 1/2
14	1,200	3 1/4	1	2 1/2
16	1,565	3 5/8	1	2 1/2
18	1,980	4 3/16	1	2 1/2

\* With 40 PSI residual pressure, a 2 1/2" hydrant outlet nozzle with discharge approximately 1,000 gpm and a 4 1/2" hydrant nozzle with discharge approximately 2,500 gmp.

F. Form of Chlorine for Disinfection - The most common forms of chlorine used in the disinfecting solutions are liquid chlorine (gas at atmospheric pressure), calcium hypochlorite granules, sodium hypochlorite solutions and calcium hypochlorite tablets.

(1) Liquid Chlorine - Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine gas directly from the supply cylinder is unsafe and shall not be permitted.

NOTE: The preferred equipment consists of a solution feed chlorinator in combination with a booster pump for injecting the chlorine-gas water mixture into the main to be



disinfected. Direct feed chlorinators are not recommended because their use is limited to situations where the water pressure is lower than the chlorine cylinder pressure.

(2) Hypochlorites

- (a) Calcium Hypochlorite - Calcium hypochlorite contains 70 percent (70%) available chlorine by weight. It is either granular or tabular in form. The tablets, 6-8 to the ounce, are designed to dissolve slowly in water (Item G, Methods of Chlorine Application, para. c). Calcium hypochlorite is packaged in containers of various types and sizes ranging from small plastic bottles to 100 pound drums.

A chlorine-water solution is prepared by dissolving the granules in water in the proportion requisite for the desired concentration.

- (b) Sodium Hypochlorite - Sodium hypochlorite is supplied in strengths from 5.25 to 16 percent available chlorine. It is packaged in liquid form in glass, rubber or plastic containers ranging in size from one-quart bottles to five-gallon carboys. It may also be purchased in bulk for delivery by tank truck.

The chlorine-water solution is prepared by adding hypochlorite to water. Product deterioration must be reckoned with in computing the quantity of sodium hypochlorite required for the desired concentration.

- (c) Application - The hypochlorite solution shall be applied to the water main with a gasoline or electrically-powered chemical feed pump designed for feeding chlorine solutions. For small applications the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

G. Methods of Chlorine Application -

- (1) Continuous Feed Method - This method is suitable for general application.

- (a) Water from the existing distribution systems or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum

of 25 mg/l available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals.

NOTE: In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume.

Table 2 below gives the amount of chlorine residual required for each 100 feet of pipe of various diameters. Solutions of one percent (1%) chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution required approximately one pound of calcium hypochlorite in 8.5 gallons of water.

- (b) During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 10 mg/l chlorine throughout the length of the main.

TABLE 2

Chlorine Required to Produce 25 mg/l Concentration in 100 feet of Pipe -- by Diameter		
Pipe Size (inches)	100 Percent Chlorine (lb)	One Percent Chlorine Solutions (gal)
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44

- (2) Slug Method - This method is suitable for use with mains of large diameter for which, because of the volumes of water involved, the continuous feed method is not practical.

- (a) Water from the existing distribution system or other approved source of

supply shall be made to flow at a constant, measured rate (Item G, Methods of Chlorine Application, Para. a, Note) into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than 100 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 50 mg/l for at least three (3) hours. The application shall be checked at a tap near the upstream end of the line by chlorine residual measurements.

- (b) As chlorinated water flows tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.
- (3) Tablet Method - Tablet disinfection is best suited to short extensions (up to 2,500 feet) and smaller diameter mains (up to 12 inches). Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised. It shall not be used if trench water or foreign material has entered the main or if the water is below 5° C (41°F).
- (a) Placement of Tablets - Tablets are placed in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench their position should be marked on the section to assure that there will be no rotation. In placing tablets in joints, they are either crushed and placed on the inside annular space, or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite.

The adhesive may be Permatex No. 1 (a product of the Permatex Company, Brooklyn, New York and Kansas City, Kansas) or any alternative approved by the Engineer. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached.

- (b) Filling and Contact - When installation has been completed, the main shall be filled with water at a velocity of less than one-foot/second. This water shall remain in the pipe for at least 24 hours.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

TABLE 4

Number of Hypochlorite Tablets of 5-G  
Required for Dose of 25 mg/l\*

Length of Section (ft)	Diameter of Pipe (in)					
	2	4	6	8	10	12
13 or less	1	1	1	1	2	3
18	1	1	1	2	3	4
20	1	1	1	2	3	4
30	1	1	2	3	4	6
40	1	1	2	4	5	7

\* Based on 3.25g available chlorine per tablet.

H. Final Flushing - After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than one mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.

I. Bacteriologic Tests -

- (1) After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies where a chlorine residual is maintained throughout the new main.

NOTE: In case of extremely long mains, it is desirable that samples be collected the length of the line as well as at its end.

- (2) Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

J. Repetition of Procedure - If the initial disinfection fails to produce satisfactory samples,

disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the samples are satisfactory, the main may be placed in service.

- K. Procedure After Cutting Into or Repairing Existing Mains - The procedures outlined in this section apply primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping device while the mains remain full of water under pressure present little danger or contamination and require no disinfection.
- (1) Trench "Treatment" - When an old line is opened, either by accident or by design, the excavation will likely be wet and badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
  - (2) Main Disinfection -
    - (a) Swabbing and Flushing - The following procedure is considered as a minimum that may be used.
    - (b) Swabbing with Hypochlorite Solution - The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with a one percent (1%) hypochlorite solution before they are installed.
    - (c) Flushing - Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.
    - (d) Slug Method - Where practicable, in addition to the procedures of Paragraph 2, SWABBING with HYPOCHLORITE SOLUTION, a section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in Item G, METHODS OF CHLORINE APPLICATION, Paragraph b, SLUG METHOD, except that the dose may be increased as much as 300 mg/l, and the contact time reduced to as little as fifteen (15) minutes. After chlorination, flushing shall be resumed and continued until discolored water is eliminated.
  - (3) Sampling - Bacteriologic sampling shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be

determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.

**SECTION 301.13 - SEPARATION OF WATER MAINS AND SEWERS** - The minimum horizontal separation shall be to ten feet where the invert of the water main is less than 18 inches above the crown of the sewer line. The minimum vertical separation shall be 18 inches at crossings. Joints in sewer crossings shall be equidistant from water mains. The upper line of a crossing shall be specially supported.

Where vertical and/or horizontal clearance cannot be maintained, the sewer or water main shall be placed in a separate casing pipe, as shown on the City of Lander Standard Drawing No. 402.02.

**SECTION 301.14 - AIR RELIEF VALVES, BLOW-OFFS, FLUSHING HYDRANTS** - These shall meet pressure and flow requirements equal to or exceeding the main installation or as required by the manufacturer.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 302  
WATER VALVES AND FIRE HYDRANTS**

**SECTION 302  
WATER VALVES AND FIRE HYDRANTS**

**SECTION 302.01 - GENERAL**

All water valves and fire hydrants within the City of Lander water system or for future acceptance into the City of Lander water system shall be installed in accordance with these specifications.

**SECTION 302.02 - ENGINEERING PLANS**

Water valve and fire hydrants shall be installed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the city engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 302.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded General Utility Contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The city engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The city engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 302.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the Contractor's or Developer's Surety.

**SECTION 302.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the city engineer.



The contractor, upon notification by the City of needed emergency repairs, shall start such work within four (4) hours and complete such work within twelve (12) hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City, at its option, may have such repairs made and invoice the contractor for the actual cost of repair.

### **SECTION 302.06 - DESCRIPTION**

This section covers valves and fire hydrants for water mains, together with related appurtenances, complete.

### **SECTION 302.07 - VALVES**

- A. Resilient Seated Gate Valves - Resilient Seated Gate Valves shall be iron body, with non-rising stems with design, construction and pressure rating conforming to AWWA Specification C-509, standard for Resilient Seated Gate Valves with modifications specified herein. **Mueller A-2370-38 or an approved equal.**

Waterway shall be smooth and shall have no depressions or cavities in seal area where foreign material can lodge and prevent closure or sealing.

Stem seals shall be double "O" ring seals designed so that the seal above the stem collar can be replaced with the valve under pressure in full open position.

Resilient Seated Gate Valves for underground installation shall have two-inch square wrench nut for key operation. All valves shall open counterclockwise unless indicated otherwise in the special provisions.

Resilient Seated Gate Valves shall be set and jointed to the pipe in the manner specified for pipe laying and jointing. Valves shall be set with operating nut vertical. Valve boxes shall be centered and plumb over the operating nut and shall be set so that no shock or stress will be transmitted to the valve.

The Resilient Seated Gate Valves' interior parts and surfaces shall be coated in accordance with AWWA C-550.

- B. Butterfly Valves - Butterfly valves for use in the water distribution system shall be Class 150 rubber seated, tight closing butterfly valves conforming to AWWA Specification C-504. Butterfly valves shall be furnished with mechanical joint ends and lubricated screw type operators designed for underground service.

Rubber valve seats shall be replaceable without disassembling the valve and shall not be interrupted by the shafting. Rubber seats may be retained on the disc edge by stainless steel clamping in lieu of bonding to the valve body. Shaft packing shall be of the self-

adjusting permanent type.

Operators for underground service shall be permanently lubricated screw-type operators, totally enclosed and of water tight construction. Overload protection shall be incorporated into the operator allowing the application of 450 foot-pounds input torque at full-open and full-closed positions without damage to the operator or valve. A two-inch square wrench nut and valve box shall be provided for operating the valve. Valves shall open counter clockwise unless indicated otherwise in the Special Provisions.

Certificate of performance, leakage and hydrostatic test as described in Section 13 of AWWA Specification C-504 shall be furnished when required by the Engineer. Valves shall be the product of a manufacturer having a minimum of five year's experience in the manufacturer of water works and distribution valves. Butterfly valves shall be Dresser Industries "450" valve, Allis-Chalmers, "Streamseal", Henry Pratt "Groundhog" or an approved equal.

### **SECTION 302.08 - VALVE BOXES**

Valves boxes shall be either cast iron or reinforced polyolefin 5" diameter and 3/16" wall thickness adjustable valve boxes. Valve boxes shall be of the screw type and of sufficient length for the pipe bury as specified. The cast iron cover of the valve box shall have an arrow indicating the direction of opening and the word "Water" stamped thereon. Reinforced polyolefin valve boxes shall be magnetically detectable.

Valves boxes shall be centered and plumb over the operating nut of the valve and maintained in this position during backfill. Tops of valve boxes shall be set flush with the ground surface or street surfacing unless otherwise directed by the engineer.

### **SECTION 302.09 - VALVE THRUST BLOCKS**

All valves to be installed which call for thrust blocks and anchor rods shall be installed in accordance with and as detailed on Standard Drawing 302.01.

### **SECTION 302.10 - FIRE HYDRANTS**

All fire hydrants to be installed within the City of Lander water system shall be Waterous Pacer Traffic Flange Hydrant, Model WB-67 and shall conform to AWWA Standard C-502 and to these specifications. Hydrants shall have a 5 1/4" main valve, 6" flange bottom connection and shall be furnished with a 6" flange by mechanical joint resilient seated gate valve and valve box. The minimum pipe depth of cover shall be 6.5 feet (7' bury). The hydrants shall be furnished with two 2 1/2" nozzles and one 4 1/2" pumper nozzle except as otherwise specified by the city engineer. The nozzle shall be threaded to conform with the National Standard Specifications. The main valve shall open left (counter clockwise) and the operating and cap nuts shall be 1 1/2" #17 national Standard Pentagonal Nut. They hydrant shall be supplied with drip valves except as

otherwise specified by the city engineer. Hydrants shall be painted with one coat of primer and two finishing coats of approved red paint in accordance with manufacturer's recommendation.

All fire hydrants shall stand plumb with the pumper nozzle facing the street and at least six inches (6") behind the sidewalk. Hydrants shall be set with the ground line at the location indicated by the hydrant manufacturer. Hydrants shall be set in line with intersection property lines, unless otherwise directed by the engineer.

Drainage shall be provided at the base of the hydrant by placing clean gravel under and around the base of the hydrant. Sufficient gravel shall be used to provide a minimum of one foot on all sides from the base of the hydrant to the point at least 6" above the drain opening. Hydrants shall be braced against unexcavated earth at the end of the trench with concrete backing as detailed on the plans. Hydrants shall be furnished with auxiliary resilient seated gate valves as specified above. Hydrant installation shall be in accordance with City of Lander Standard Drawing No. 302.02.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 303  
WATER SERVICE CONNECTIONS**

**SECTION 303**  
**WATER SERVICE CONNECTIONS**

**SECTION 303.01 - GENERAL**

All water service connections constructed within the City of Lander water system or for future acceptance into the City of Lander water system shall be installed in accordance with these specifications. These specifications shall cover all new water service construction from existing water mains to the building piping.

**SECTION 303.02 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general utility contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The city engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The city engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 303.03 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the Contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 303.04 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the city engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four hours and complete such work within twelve hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City at its option may have such repairs made and invoice the contractor for the actual cost of repair.

### **SECTION 303.05 - DESCRIPTION**

This section covers construction of water services, including water service piping, tapping the main, corporation stops, curb stops and other related items, complete to the curb box or structure, as the case may be.

### **SECTION 303.06 - SIZE**

Service lines shall be considered 2" size and under. Service lines over 2" size shall be considered as water mains and shall be as specified under the applicable sections. Installation of water service line shall be in accordance with Standard Drawing 303.01.

### **SECTION 303.07 - TRENCH EXCAVATION, BACKFILL AND BEDDING**

Trench excavation and backfill shall conform to the requirements of Section 201, TRENCH EXCAVATION, BACKFILL AND RESTORATION FOR UNDERGROUND CITY AND PRIVATE UTILITIES OF THE CITY OF LANDER STANDARDS AND SPECIFICATIONS. Service line bedding shall conform to Type 1 bedding and placement under applicable portions of Section 201.09 TRENCH BACKFILL.

### **SECTION 303.08 - MATERIALS**

- A. Water Service Pipe - The pipe shall be type K soft copper conforming to Federal Specification WW-T-799 or ASTM Specification B88-62, from the water main to the curb box and types K or L shall be used from the curb box to the structure, except for service lines over 50 feet in length from the curb box, the pipe may be ASTM D2239 (AWWA C901) Polyethylene clear core, 160 PSI pipe or ASTM D1785 PVC schedule 40 pipe rather than copper. Where the structure is over 50 feet from the curb box, a pit water meter shall be placed adjacent to the curb box and shall include a double check valve in the installation.
- B. Corporation Stops - Corporation stops shall be Mueller H-15000.
- C. Service Clamps - Service clamps, where required, shall be flat double strap, bronze metal, with Neoprene gaskets and corporation stop threads, Mueller 104 or 105. Service clamps for PVC shall provide full support around the circumference of the pipe and have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when tightened.
- D. Curb Stops - Curb stops shall be Mueller #H15201. Curb boxes shall be cast iron Mueller H10314, 1" riser arch pattern and 5' x 7' extension.
- E. Meter Yokes - Meter yokes shall be Ford #81 copper setter.

- F. Water meters - Water meters will be supplied, installed and maintained by the City of Lander under City Ordinance #652.
- G. Pit Meter Installations - Pit meter installations shall have an inner frost cover and work lock outer cover, Casting Inc. M-70 A.L. or equivalent.

**SECTION 303.09 - SERVICE LINE INSTALLATION** - The contractor shall provide all work and materials for the complete service line installation, including trench excavation and backfill; making the water main tap, furnishing and installing the corporation stop, curb stop and box, service clamp where necessary and service line with fittings as required to make the connections to the stops. The service line adjacent to the water main shall be bent sideways slightly into a low gooseneck to avoid a rigid connection. All services shall have a minimum of six and one half (6.5) feet of cover. See Standard Drawing 303.01. The service line shall be one continuous length without joint or connections from the main to the curb stop and from the curb stop to its connection with the in-house plumbing. The curb box shall be located 3.5 feet behind the back of curb and to a minimum height equal to the curb grade or set flush in the sidewalk. On machine placed sidewalks the curb box may be located 6.0 feet behind the back of curb. The service connection shall be located a minimum of ten (10) feet from any fire hydrant or blowoff valve. The distance to be measured along the horizontal centerline of the pipe.

**SECTION 303.10 - TAPPING** - New corporation stops and service may be installed on existing mains. The utility contractor shall request a street and alley excavation permit from the City and return it to the City along with the required fees. The utility contractor shall do all the work, including any restoration, according to the applicable City of Lander, Standards and Specifications.

Tapping to accommodate a manifold hookup will be staggered on a minimum of 18" centers, in accordance with the tap sizes below.

Tapping shall be done using an approved tapping machine and clean sharp drill taps. Tapping direct into AWWA C900 DR25 PVC pipe will not be allowed. Tapping direct into AWWA C900 DR18 PVC pipe or DR14 PVC pipe will not be allowed unless otherwise specified.

AWWA C950 Fiber Glass Composite Pipe may be tapped direct using 3/4" or 3/4" x 1" Hays Seal Corporation Stops. The use of these stops is limited to pipe sizes 8" and above for maximum operating pressures of 150 psi. Maximum size taps directly into the barrel of water main pipes will be permitted as follows:

MAXIMUM TAP SIZE			
Pipe Size	PVC AWWA C900 DR14 & DR18*	Ductile Iron and Steel	Concrete Cylinder Pipe

6"	1"	1"	3/4"
8"	1"	1 1/4"	1"
10"	1"	1 1/4"	1"
12" & Larger	1"	2"	1"

\* Tapping not allowed unless otherwise specified.

Tapping directly into the barrel of water main pipe shall be at the proper depth to permit a maximum of three threads of the corporation stop to be exposed. Larger taps may be made using service clamps or bossed sleeves. Maximum tap sizes with service clamps shall be 1 1/2" for 6" diameter mains and 2" for mains 8" in diameter and larger.

**SECTION 303.11 - REPAIR** - Any repair made to an existing damaged water service line, as opposed to a new installation may be exempt from the continuous length provision of Section 303.09. The repair shall be spliced with a flared coupling.



**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 401  
SANITARY SEWER MAINS**

SECTION 401  
SANITARY SEWER MAINS

**SECTION 401.01 - GENERAL** - All sanitary sewer mains construction within the City of Lander sewer system or for future acceptance into the City of Lander sewer system shall be installed in accordance with these specifications.

**SECTION 401.02 - ENGINEERING PLANS** - Sanitary sewer mains shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the city engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 401.03 - LICENSES AND PERMIT REQUIRED** - All construction shall be performed by a licensed and bonded general utility contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The city engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The city engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 401.04 - INSPECTION AND TESTING** - All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 401.05 - WARRANTY OF WORK** - The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City Engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four (4) hours and complete such work with twelve (12) hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City, at its option, may have such repairs made and invoice the contractor for the actual cost of repair.

**SECTION 401.06 - DESCRIPTION**

- A. General - This section covers construction of sanitary sewer mains, including manholes and other appurtenant structures, complete.
- B. Replacement of Existing Sanitary Sewer Mains - This work will be accomplished with as little disruption of sewer service and traffic as possible. All new replacement sewer mains will be laid on the same location and grade as the existing mains. Salvage pipe will be removed and disposed of by the contractor.

Each section of completed main shall be deflection tested, and cleaned according to these specifications, before being accepted.

Individual driveways, shall be reopened, with a temporary gravel surface, at the end of each working day. Restoration of each street or alley shall be completed within two weeks after completion of the pipe laying in that particular section.

#### **SECTION 401.07 - GRAVITY SEWER MAIN MATERIALS**

- A. General - Sewer pipe and fittings furnished under this contract shall be as hereinafter specified. Wye or tee branches shall be of the same material and design as the sewer pipe used.

- B. Materials

- (1) Polyvinyl Chloride (PVC) Pipe

- (a) Pipe - PVC sewer pipe shall be produced by a continuous extrusion process, employing a prime grade of unplasticized polyvinyl chloride. The grade used shall be highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals commonly found in sewage and industrial wastes. The material shall conform to the requirements of the specifications for "Rigid Polyvinyl Chloride Compounds", ASTM Designation D-1784. The pipe shall have self-extinguishing flammability characteristics.

Pipe and fittings shall conform to ASTM Designation D-3034, "Standard Specification for Polyvinyl Chloride Sewer Pipe and Fittings." PVC pipe shall have a minimum Standard Dimension Ratio of SDR 35.

Nominal laying lengths shall be not less than 12.5 feet, except shorter lengths may be used adjacent to manholes, lamp holes or other appurtenances. Each length of pipe shall be marked with size, SDR, "Sewer Pipe" and Code Number.

- (b) Pipe Jointing - Each length of pipe shall be provided with a bell designed so that a water tight joint will be obtained when jointing the bell and spigot with a rubber ring.

The rubber gasket joint for PVC pipe and fittings shall consist of a rubber gasket which is compressed between the outer surface of the spigot and the inner surface of a retaining groove in the bell.

The joint shall be completely sealed by the gasket so that the assembly will remain watertight under all conditions of service, including movements resulting from expansion, contraction, settlement and deformation of the pipe. The rubber ring joint assembly shall be made in strict accordance with the manufacturer's recommendation.

- (c) Fittings - Wye or tee fittings for connection service lines shall be of the same material, construction and joint design as the main sewer pipe. Tapping saddles shall have rubber gaskets and be attached with stainless steel bands.
- (d) Deflection Testing - All PVC mains shall be deflection tested in accordance with Section 401.10 Tests D.

(2) Ductile Iron Pipe -

- (a) Pipe - Ductile iron pipe shall conform in all aspects to the latest revisions of ASTM, Standards Specifications A 746.
- (b) Fittings - Wye or tee fittings for connecting service lines shall be of the same material, construction and joint design as the main sewer pipe or a method approved by the engineer.
- (c) Pipe Joint - All field joints shall meet the manufacturer's requirement for the brand of pipe being used.

(3) Casing Pipe - Pipe used to case waterline, sewer line crossings shall be (PVC) DR-26 with a minimum diameter of 1.25 times O.D. of carrier pipe.

- C. Certification by Manufacturer - When required by the engineer, the contractor shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe and fittings comply with the applicable specifications.
- D. All pipe shall be clearly marked with type, class and/or, thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.
- E. Type of joint, class, thickness designation, casting, lining, marking, testing, etc., shall be as specified.

## **SECTION 401.08 - PIPE INSTALLATION**

- A. Excavation and Backfill - Excavation and backfill for sewer mains shall conform to the applicable portions of Section 201, "Trench Excavation, Backfill and Restoration for Underground City and Private Utilities of the City of Lander Standards and Specifications."
- B. Bedding - Bedding of sewer mains shall conform to type 2 pipe bedding and placement under applicable portions of Section 201, "Trench Excavation, Backfill and Restoration for Underground City and Private Utilities of the City of Lander Standards and Specifications."
- C. Responsibility for Material - The contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work or during the guarantee period.

The contractor shall be responsible for the safe storage of material intended for the work until it has been incorporated in the complete project.

- D. Handling of Pipe - All pipe furnished by the contractor shall be delivered and distributed at the site by the contractor. Pipe, fitting and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.

Pipe shall be handled so that no coating or lining will be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the contractor or at his expense in a manner satisfactory to the engineer.

- E. Laying Pipe - All pipe shall be laid and maintained to the required lines and grades with fittings, tees and manholes at the required locations.

The contractor shall use good workmanship. All pipe shall be properly jointed home, using wood cushion and protective devices in accordance with manufacturer's recommendations.

Proper tools and equipment satisfactory to the engineer shall be used by the contractor for

the safe and convenient prosecution of work. All pipe and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a plug or other means approved by the engineer. The contractor shall clean and remove all sand, gravel, concrete and cement grout that has entered the lines in the process of construction.

The bottom of the trench shall be shaped to fit the bottom quadrant of the pipe, with holes for couplings just large enough to permit their assembly.

- F. Tolerances - The sewers shall be installed within 1/4" for grade and shall not be of more than 1/2" for alignment. The engineer shall specify joint deflection tolerance where acceptable.

#### **SECTION 401.09 - MANHOLES**

- A. General - Manholes shall be constructed of precast concrete rings with frames and covers and steps in accordance with details shown on Standard Drawings 401-01, 401-02, 401-03 and 401-04.
- B. Precast Concrete Rings - Precast concrete rings for manholes shall conform to specifications for "Precast Reinforced Concrete Manhole Risers and Tops." ASTM C-478.

Adjusting rings may be used for adjusting the manhole top elevation to coincide with existing ground elevations, except the total height of adjusting rings used per manhole shall not exceed 12 inches. Adjusting rings shall be reinforced with the same percentage of steel as the riser and top.

- C. Steps - Non-corrosive steps of rubber encased steel, aluminum, or nylon shall be used. Steps shall withstand vertical loads of 400 pounds and pull-out resistance of 1,000 pounds.
- D. All manholes shall be designed to withstand H-20 AASHTO Loading.
- E. Rings and Covers - Gray cast iron conforming to ASTM-A-48 with machined metal bearing surfaces.

The following have been approved for the application indicated as meeting this specification.

ALLOY	MANUFACTURER	RINGS & COVERS SANITARY SEWER
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Cast Iron	Neenah Foundry	R-1925
Cast Iron	Comco Foundry	425-B
Cast Iron	Municipal Castings Inc.	315
Cast Iron	Comco Foundry	C-1114

F. Concrete Base - Reinforced concrete base shall be precast or poured in the field of undisturbed earth. Concrete shall conform to Section 501, Portland Cement Concrete.

G. Construction - Manholes shall be constructed to the general dimensions shown. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be half pipe laid in concrete. The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one (1) inch per foot, nor more than two (2) inches per foot.

Free drop inside the manhole shall not exceed two feet measured from the invert of the inlet pipe to the invert of the outlet pipe., Where the drop exceeds two feet, drop manholes shall be constructed as shown on the typical manhole detail.

All connections between wall sections or between sewer pipe and manhole walls shall be joined with "Kent Seal" manufactured by K.T. Snyder Company, or approved equal, in such a manner as to make the manhole watertight. Rubber "O" ring gaskets may be used if approved by the engineer.

Manhole construction shall not be greater than one manhole distance behind sewer construction, unless otherwise allowed by the engineer.

## SECTION 401.10 TESTS

- A. T.V. Inspection - In the event a sewer installation fails to pass any required test after usual and customary methods of repair have been employed by the contractor, the City may, at their option, require any or all sewer mains to be inspected by the use of a television camera before final acceptance. The cost incurred in making the initial inspection shall be borne by the owner. The contractor will turn over to the City a copy of the video (VCR) tape as a record of the test and any repairs.

The contractor shall bear all costs incurred in correcting any deficiencies found during television inspection including the cost of any additional television inspection that may be required by the City to verify the correction of said deficiency.

The contractor shall be responsible for all costs incurred in any television inspection performed solely for the benefit of the contractor.

- B. Leakage Test - New sewer lines will not be finally accepted until leakage tests have been made to assure the engineer that pipe laying and jointing are satisfactory.

1. Water Test - Where groundwater is above the sewer line, tests shall be made by sealing off the section of lines between manholes and measuring the actual flow by collecting or pumping the discharge into barrels or other approved methods. Tests shall be continued over a period of at least four (4) hours for each section tested. Sufficient time shall be allowed to soak lines and manholes in advance of performing tests.

When ground water is not above the pipe, testings shall be as follows: On flat slopes where the depth over the centerline of the pipe in the lower manhole of the section being tested will not be more than ten feet (10'), the upper manhole shall be filled to a depth of two feet (2') over the top of the pipe and the lower manhole blocked. When the above conditions cannot be met, the engineer may order the contractor to test the line in sections between manholes. The leakage shall be measured by checking the drop in water level in the manhole over a period of four (4) hours.

The maximum allowable infiltration or exfiltration, including manholes, shall not exceed 200 gallons per day per mile of sewer, per inch of pipe diameter. This does not preclude the fact that obvious and concentrated leaks, such as open joints, pinched gaskets, cracked barrels or bells, etc., will not be allowed. The contractor shall make repairs on concentrated leaks and as necessary to reduce infiltration or exfiltration leakage below the specified rate and at his own expense. Allowable leakage below the specified rate and at his own expense. Allowable leakage in gallons/24 hours shall not exceed: (length of line in feet)(pipe diameters in inches)(0.03788).



2. Air Test (Alternate) - As an alternate method of water testing, the contractor may utilize low pressure air as a means of testing the sewer mains. The procedure shall be as described below:

Plug both ends of the pipe under test with air-tight plugs and brace adequately to prevent slippage and blowout. One plug shall have an inlet tap or other provision for connecting an air hose.

The air supply hose, connected between the air compressor and the plug, shall have a throttling valve, an air bleed valve and a high pressure shut-off valve for control. The low pressure side of the throttling valve shall have a tee for a monitoring pressure gauge, protected by a gauge cock. This cock is kept closed except when the pressure loss is being timed.

If the pipeline is submerged under ground water, the back pressure, caused by the water head, is measured and added to the standard test pressures to compensate for the ground water effect on the air test.

Air shall be applied slowly to the pipe line until the pressure reaches 4.0 psig. The air supply shall then be throttled so that the internal pressure is maintained between 4.0 and 3.5 psig for at least two (2) minutes. During this time the plugs shall be checked with soap solution to detect any plug leakage.

When the pressure reaches exactly 3.5 psig, a stop watch is started and the time recorded for the pressure to drop to 2.5 psig. The minimum time allowed for this pressure drop shall be computed based on an air loss rate of 2.0 cfm or an air loss rate of 0.0030 cfm per square foot of inner pipe surface under test, whichever rate gives the least time for the pressure drop. Should the time of the pressure drop between 3.5 and 2.5 psig be less than the allowable specified time, the contractor shall make the necessary leakage repairs and repeat the air test.

Table 1 on page 10 provides a Nomograph which may be used to compute testing times for air testing.

Manhole joints shall be checked for leakage by means of water testing as specified above.

- C. Deflection Testing - After the pipe has been laid and backfilled, all pipe shall be tested for deflection in the presence of the engineer. The test shall consist of pulling a deflection gauge through the pipe. The maximum deflection allowable shall not exceed 5%, as set forth in the table below, the final inspection. The contractor shall conduct the test and shall furnish all necessary test equipment and labor. The contractor's gauge shall be proofed against the City's proving ring or he may use a gauge furnished by the City.

All pipe sections failing the test shall either be rebedded or removed and replaced at the contractor's expense. The contractor shall then backfill and retest those sections.

**5% DEFLECTION/GAUGE DIMENSIONS**

Nominal Diameter Inch	PVC - Sewer Pipe ASTM D3034-81
6	5.45
8	7.28
10	9.08
12	10.79
15	13.20

- D. Number of Tests - A sufficient number of leakage tests shall be performed to assure the engineer that materials and workmanship are acceptable. Defective joints shall be repaired only by use of approved jointing materials which is flexible when set and that has a permanent bond to the pipe. Pipes having cracked or broken barrels shall be replaced. The length of sewer line tested per test shall not exceed 800 feet.
- E. Materials and Equipment for Testing - Except as noted in paragraph B, all labor, equipment and materials (including water) necessary for making the test of sewer lines shall be furnished by the contractor.
- F. All tests shall be made after backfill is completed, but prior to any surface restoration or street surfacing. The contractor shall be responsible for finding and repairing all breaks and leaks revealed by the tests.

**SECTION 401.11 - SEPARATION OF SEWER MAINS AND WATER MAINS** - The minimum horizontal separation shall be ten feet where the invert of the water main is less than 18 inches above the crown of the sewer line. The minimum vertical separation shall be 18 inches at crossings, joints in sewer crossings shall be located equidistant from water mains. The upper line of a crossing shall be specially supported.

Where vertical and/or horizontal clearances cannot be maintained the sewer or water main shall be placed in a separate casing pipe, as shown on the City of Lander standard drawing No. 402.02.

TABLE 2 - AIR TEST TABLE

Based on Formulas From ASTM C 828

SPECIFICATION TIME (MIN:SEC) REQRUIED FOR PRESSURE DROP FROM 3½ TO 2½ PSIG  
WHEN TESTING ONE PIPE DIAMETER ONLY  
PIPE DIAMETER, INCHES

	4	6	8	10	12	15	18	21	24	27	30	33	36	39	42
25	0:04	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56	6:58	8:05
50	0:09	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53	13:57	16:10
75	0:13	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00	18:25	19:50
100	0:18	0:40	1:11	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:10	15:35			
125	0:22	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20					19:58	23:06
150	0:26	0:59	1:46	2:45	3:58	6:11	8:30					17:09	20:25	23:57	27:43
175	0:31	1:09	2:03	3:13	4:37	7:05				13:24	16:32	20:01	23:49	27:57	32:20
200	0:35	1:19	2:21	3:40	5:17				12:06	15:19	18:54	22:52	27:13	31:56	36:58
225	0:40	1:29	2:38	4:08	5:40			10:25	13:36	17:13	21:16	25:44	30:37	35:56	41:35
250	0:44	1:39	2:56	4:35			8:31	11:35	15:07	19:08	23:38	28:35	34:01	39:56	46:12
275	0:48	1:49	3:14	4:43			9:21	12:44	16:38	21:03	25:59	31:27	37:25	43:55	50:49
300	0:53	1:59	3:31				10:12	13:53	18:09	22:58	28:21	34:18	40:49	47:55	55:26
350	1:02	2:19	3:47			8:16	11:54	16:12	21:10	26:47	33:05	40:01	47:38	55:54	64:41
400	1:10	2:38			6:03	9:27	13:36	18:31	24:12	30:37	37:48	45:44	54:26	63:53	73:55
450	1:19	2:50			6:48	10:38	15:19	20:50	27:13	34:27	42:32	51:27	61:14	71:52	83:10
500	1:28			5:14	7:34	11:49	17:01	23:09	30:14	38:16	47:15	57:10	68:02	79:51	92:24
550	1:37			5:45	8:19	13:00	18:43	25:28	33:16	42:06	51:59	62:53	74:51	87:50	101:38
600	1:46		4:02	6:17	9:04	14:11	20:25	27:47	36:17	45:56	56:42	68:36	81:39	95:49	110:53

650	1:54	2:50	4:22	6:48	9:50	15:21	22:07	30:06	39:19	49:45	61:26	74:19	88:27	103:48	120:07
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**CITY OF LANDER  
STANDARDS & SPECIFICATIONS  
SECTION 402  
SANITARY SEWER SERVICES**

**SECTION 402  
SANITARY SEWER SERVICES**

**SECTION 402.01 - GENERAL**

All sanitary sewer services construction within the City of Lander sewer system or for future acceptance into the City of Lander sewer system shall be installed in accordance with these specifications.

**SECTION 402.02 - ENGINEERING PLANS**

Sanitary sewer services shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City Engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 402.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general utility contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 402.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 402.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four hours and complete such work within twelve hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City at its option may have such repairs made and invoice the contractor for the actual cost of repair.

#### **SECTION 402.06 - DESCRIPTION**

This section covers construction of sanitary sewer services complete.

#### **SECTION 402.07 - GRAVITY SEWER SERVICE MATERIALS**

- A. General - All sewer service pipe shall be PVC, ASTM designation D-3034, with gasketed slip joint. The PVC pipe shall have a minimum standard dimension ratio of SDR 35. Wye or tee branches shall be of the same material and design as the sewer main, on new main installations.

Hubless cast iron soil pipe ASTM designation A74-72 and ASTM D-3034 sewer pipe, PVC building drain pipe, ASTM designation D-1785 schedule 40 or D-2665 schedule 40, all with glued joints may be used from the structure to the lot boundary rather than D-3034 gasketed slip joint sewer pipe.

- B. Certification by Manufacturer - The contractor shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe and fittings comply with the applicable specifications, when required by the engineer.
- C. Where the reference is made to an ASTM, ANSI or AASHTO designation, it shall be the latest revision at the time of call for bids, except as noted on the plans or in the Special Provisions.
- D. All pipe shall be clearly marked with type, class and/or, thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

#### **SECTION 402.08 - JOINTING TO MAIN LINE SEWER**

Wye to tee fittings shall be installed in the mainline sewer for connection of service lines. Wye or tee fittings shall be of the same material and design and of the same specifications as the sewer main pipe. Jointing of service pipe to wye or tee branches of main line pipe or other PVC, shall be accomplished with special joint adapters manufactured specifically for jointing the two different types of pipe.

The City's representative shall inspect the main and saddle for each tap prior to backfilling. In the event the tap is covered before it is inspected, it shall be dug out by the contractor and any concrete mortar or epoxy around the fitting shall be removed to allow visual inspection of the tap

and the main. If the main sewer line is cracked or broken during the process of locating and tapping, it shall be repaired immediately, either by replacing the broken section or by placing a minimum of nine (9) inches of concrete encasement around the section.

New sewer taps and service may be installed on existing sewer mains. The utility contractor shall request a street and alley excavation permit from the City and return it to the City, along with the required fees. The utility contractor shall do all the work, including any restoration, according to the applicable City of Lander Standards and Specifications.

**SECTION 402.09 - INSTALLATION**

- A. General - Service lines shall be constructed in accordance with Standard Drawing 402-01. The service line shall extend from the sewer main to the property line or within two (2) feet of the structure as the case may be. The end of the service line shall be plugged with an approved cap or plug. Grouting of plugs will not be permitted.
- B. Excavation and Backfill - Excavation and backfill for pipelines shall conform to the applicable portions of Section 201, Trench Excavation, Backfill and Restoration for Underground City and Private Utilities of the City of Lander Standards and Specifications.
- C. Bedding - Bedding of sewer mains shall conform to type 2 pipe bedding and placement under applicable portions of Section 201, "Trench Excavation Backfill and Restoration for Underground City and Private Utilities of the City of Lander Standards and Specifications".
- D. Alignment of Sanitary Service Lines - Sanitary service lines shall be aligned in the shortest, most direct path between the sanitary main and the house. When possible, the line shall be located ten feet from the low side of the lot and not closer than ten feet from the water service line.

When necessary, the service may be constructed with one horizontal one-eighth bend between the house plumbing and the sanitary sewer main as shown on the City of Lander Standard Drawing 402-01. When additional bends would be required because of the alignment of the house plumbing, it is the responsibility of the plumber to correct the plumbing to meet the above requirement. House plumbing shall come out of the house on the side facing the main to which connection is to be made.

The minimum allowable gradient for sanitary service lines are as follows:

<u>Diameter</u>	<u>Minimum Gradient Ft./100 Ft.</u>	<u>Minimum Fall In./Ft.</u>
4"	1.20	1/4"
6"	0.64	1/8"



In general, all commercial units should be served by a minimum six (6") service line.

Tapping sewer mains to connect 6 inch and larger service lines of those which serve buildings intended for industrial, manufacturing or other "process" uses, will not be allowed. This size and type of service shall be connected to the main through a manhole with a formed invert.

Sanitary service lines are not allowed to cross property other than the property being served, unless prior approval has been obtained from the City engineer.

- E. Separation of Sewer Service and Water Mains - The minimum vertical separation shall be 18 inches at crossings. Joints in sewer crossings shall be located equidistant from water mains. The upper line of a crossing shall be specially supported.
- F. Responsibility for Material - The contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work or during the guarantee period.

The contractor shall be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

- G. Handling of Pipe - All pipe furnished by the contractor shall be delivered and distributed at the site by the contractor. Pipe, fittings and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.

Pipe shall be handled so that no coating or lining will be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the contractor at his expense in a manner satisfactory to the engineer.

- H. Laying Pipe - All pipe shall be laid and maintained to the required lines and grades with fittings, tees and manholes at the required locations.

Proper tools and equipment satisfactory to the engineer shall be used by the contractor for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and protective coatings and linings. Under no circumstances shall materials be dropped or

dumped into the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a plug or other means approved by the engineer. The contractor shall clean and remove all sand, gravel, concrete and cement grout that has entered the lines in the process of construction.

The bottom of the trench shall be shaped to fit the bottom quadrant of the pipe, with holes from couplings just large enough to permit their assembly.

- I. Tolerances - The sewers shall be installed within ¼" from grade and shall not be off more than ½" for alignment.

#### **SECTION 402.10 - RESTORATION, FINISHING AND CLEANUP -**

The contractor shall restore and/or replace all paved surfaces, curbing, sidewalks or other disturbed surfaces to their original conditions per Section 201.13, Surface Restoration. All surplus material and temporary structure, as well as all excess excavation shall be removed and the entire site of contractor operations shall be left in a neat and clean condition, as specified in Section 201.14, Cleanup.

#### **SECTION 402.11 - EXTENDING SEWER SERVICES INTO PRIVATE PROPERTY -**

Unless otherwise provided by local sewer ordinances, the property owners will be permitted to extend sewer services onto their property and connect fixtures thereto, as soon as the main sewer construction has progressed past the point of side sewer construction and leakage tests have been satisfactorily completed, provided the use of the connections will not interfere with the completion of the other parts of the contract work and provided the extension is approved by the engineer. Such sewer service connection shall be allowed only after final inspection and acceptance of main sewer.

**SECTION 402.12 - END PIPE MARKER -**

Locations of sewer services shall be marked by the contractor at the property line as directed by the engineer.

**CITY OF LANDER  
STANDARDS & SPECIFICATIONS  
SECTION 403  
STORM DRAINS AND CULVERTS**

**SECTION 403  
STORM DRAINS AND CULVERTS**

**SECTION 403.01 - GENERAL**

All storm drains and culverts constructed within the City of Lander street system or for future acceptance into the City of Lander street system shall be installed in accordance with these specifications.

**SECTION 403.02 - ENGINEERING PLANS**

Storm drains and culverts shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 403.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general utility contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 403.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 403.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four (4) hours and complete such work within twelve (12) hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City at its option may have such repairs made and invoice the contractor for the actual cost of repair.

#### **SECTION 403.06 - DESCRIPTION**

This section covers construction of drainage culverts and storm drains including manholes, inlets and other appurtenant structures, complete.

#### **SECTION 403.07 - STORM DRAIN AND CULVERT PIPE MATERIALS**

- A. General - All storm drain and culvert piping shall be as called out in the proposal and/or plans shall be in accordance with materials and testing as specified in this section. Pipe sizes and strength classification shall be as shown on the plans and/or listed in the proposal.
- 1) Corrugated Steel Pipe - Corrugate steel pipe and coupling bands for culverts shall meet the requirements of AASHTO M-36 for the specified sectional dimensions. One foot minimum cover will be required when used in streets and alleys. CMP culvert and coating selection shall be based on Ph and resistivity tests and fifty year expected life.
  - 2) Concrete Pipe - Pipe for storm drains and culverts shall be reinforced concrete pipe conforming to ASTM specification C-76 or non-reinforced concrete pipe conforming to ASTM C-14. Joints for concrete pipe shall be rubber gasket type conforming to ASTM C-443. C-76 culvert pipe shall be used in streets and alleys. A one foot minimum cover will be required for Class V pipe and two foot minimum cover for Class III pipe.
  - 3) Poly Vinyl Chloride (PVC) Pipe - PVC pipe for storm drains shall meet the requirements of ASTM Specifications D-2241 or D-3034 when used in streets or alleys. A one foot minimum cover will be required for ASTM D-2241 pipe, with an SDR of 25 and two foot minimum cover for ASTM D-3034 pipe with an SDR of 35 when used in streets and alleys. ASTM D-2241 is limited to 12 inches and smaller diameters.
- B. Certification by Manufacturer - The contractor shall furnish certification by the manufacturer of the pipe to be furnished on this project, certifying that the pipe complies with the applicable specifications, when required by the engineer.
- C. Where reference is made to an ASTM, ANSI, AASHTO designation, it shall be the latest revision at the time of call for bids, except as noted on the plans or in the special

provisions.

- D. All pipe shall be clearly marked with type, class and/or, thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.
- E. Type of joint, class, thickness designation, casting, lining, marking, testing, etc., shall be specified.

#### **SECTION 403.07 - PIPE INSTALLATION**

- A. Excavation and Backfill - Excavation and backfill for pipelines shall conform to the applicable portions of Section 201 - Trench Excavation, Backfill and Restoration for Underground City and Private Utilities of the City of Lander Standards and Specifications.
- B. Responsibility for Material - The contractor shall be responsible for all material furnished by him and shall replace at his own expense all such material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include furnishing all material and labor required for the replacement of installed material discovered defective prior to final acceptance of the work or during the guarantee period.

The contractor shall be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

- C. Handling of Pipe - All pipe furnished by the contractor shall be delivered and distributed at the site by the contractor. Pipe, fittings and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The interior of all pipe and other accessories shall be kept free from dirt and foreign matter at all times.

Pipe shall be handled so that no coating or lining will be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the contractor at his expense in a manner satisfactory to the engineer.

- D. Laying Pipe - All pipe shall be laid and maintained to the required lines and grades with fittings, tees and manholes at the required locations.

Proper tools and equipment satisfactory to the engineer shall be used by the contractor for the safe and convenient prosecution of the work. All pipe and fittings shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and

protective coatings and linings. Under no circumstances shall materials be dropped or dumped into the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a plug or other means approved by the engineer. The contractor shall clean and remove all sand, gravel, concrete and cement grout that has entered the lines in the process of construction.

Bell holes in bottom of trench required where needed.

- E. Tolerances - The sewers shall be installed within 1" for grade and shall not be off more than 2" for alignment.

**SECTION 403.09 - MANHOLES**

- A. General - Manholes shall be constructed of precast concrete rings with frames and covers and steps in accordance with details shown on Standard Drawings 401-01, 401-02, 401-03 and 401-04.
- B. Precast Concrete Rings - Precast concrete rings for manholes shall conform to specifications for "Precast Reinforced Concrete Manhole Risers and Tops", ASTM C-478.

Adjusting rings may be used for adjusting the manhole top elevation to coincide with existing ground elevation, except the total height of adjusting rings used per manhole shall not exceed 12 inches. Adjusting rings shall be reinforced with the same percentage of steel as the riser and top and shall be supplied with non-slip lugs to match grooves in the precast manhole top.

- C. Steps - Non-corrosive steps of rubber encased steel, aluminum or nylon shall be used. Steps shall withstand vertical loads of 400 pounds and pull-out resistance of 1,000 pounds.
- D. Rings and Covers - Rings and covers shall be gray cast iron conforming to ASTM-A-48 with machined metal bearing surfaces.

The following have been approved for the application indicated as meeting the specification:

ALLOY	RINGS & COVERS	INLET FRAME AND GRATES	MANUFACTURER
Cast Iron	R-1925	R-3236	Neenah Foundry



Cast Iron		R-3237	Neenah Foundry
Cast Iron		R-3746-A*	Neenah Foundry
Cast Iron		R-3296-A*	Neenah Foundry
Cast Iron	425-B		Comco Foundry
Cast Iron	315		Municipal Castings Inc.
Cast Iron	C-1114		Comco Foundry

\* To be furnished with diagonal grates.

- E. Concrete Base - Concrete base will be precast or poured in the field on undisturbed earth. Concrete shall conform to Section 501 - Portland Cement Concrete.
- F. Construction - Manholes shall be constructed to the general dimensions shown. Invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels may be formed directly in the concrete of the manhole base or may be half-pipe laid in concrete. The floor of the manhole outside the channel shall be smooth and shall slope toward the channel not less than one inch (1") per foot, nor more than two inches (2") per foot.

All connections between wall sections or between sewer pipe and manhole walls shall be joined with "Ram-nek", "Kent Seal" manufactured by K.T. Snyder Company or approved equal, in such a manner to make the manhole watertight.

Manhole construction shall be not greater than one manhole distant behind pipe construction, unless approved by the engineer.

### **SECTION 403.10 - INLETS, CATCH BASINS AND SLOTTED DRAINS**

Inlets, catch basins and slotted drains shall be constructed as shown on City of Lander Standard Drawings 403.01 through 403.03 and on plans submitted for approval. Inlet frames and gratings shall be standard cast iron frames and grates, as shown on the Standard Drawings and under Section 403.09 D.

Inlet structures shall be constructed to the line, cross section and dimensions shown. Concrete and reinforcing steel shall conform to Section 501 - Portland Cement Concrete and Section 502 - Reinforcing Steel. Inlet structures may be precast or cast-in-place.

### **SECTION 403.11 - TESTS**

- A. Light Test - After the trench has been backfilled, a light test shall be made between manholes to check alignment and grade for displacement of pipe. Except for curved alignments shown on the plans, the completed pipeline shall be such that a true circle of light can be seen from one manhole to the next. If alignment or grade is other than specified and displacement of pipe is found, the contractor shall remedy such defects at his own expense.
  
- B. Leakage Test - Unless specified in the special provisions, a leakage test will not be required. However, this does not preclude the fact that obvious and concentrated leaks (such as open joints, pinched gaskets, cracked barrels or bells, etc.) will not be allowed.

**CITY OF LANDER  
STANDARDS AND SPECIFICATIONS  
SECTION 501  
PORTLAND CEMENT CONCRETE**

**SECTION 501  
PORTLAND CEMENT CONCRETE**

**SECTION 501.01 - GENERAL**

All Portland Cement concrete construction within the City of Lander or for future acceptance into the City of Lander street system shall be installed in accordance with these specifications.

**SECTION 501.02 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City engineer shall be notified twenty-four(24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 501.03 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 501.04 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

**SECTION 501.05 - DESCRIPTION**

Portland Cement Concrete shall meet all specification requirements and shall be composed of Portland cement, fine and coarse aggregates, water and other materials as provided for in these specifications.

- A) Air-Entrained Concrete - All concrete shall be air-entrained. Air-entrained Portland Cement shall only be used as directed by the Engineer.

**SECTION 501.06 - CLASSIFICATION AND PROPORTIONING**

The Concrete Class Table on the following page shows the classes of concrete that are included in these specifications and shall be used where required by the plans and as minimums.

#### **501.07 - COMPOSITION OF CONCRETE**

Upon receipt of the notice of award of the contract, the contractor shall furnish the engineer with names of suppliers and locations of sources of materials which he proposed to use.

A) Design

- 1) The design volume of coarse aggregate, fine aggregate and the minimum allowable cement measured into each batch shall be in accordance with a laboratory mix design prepared by an approved independent testing laboratory.
- 2) The laboratory mix design, prepared by an independent testing laboratory, shall be furnished by the contractor and approved by the engineer.

#### **SECTION 501.08 - MATERIAL**

- A) Cement - Portland Cement shall conform to the requirements of AASHTO M-85, ASTM C-150 or ASTM C-175, Types I, II, III, and V, the type of cement to be specified by the engineer.

Only one brand of cement shall be used on the contract except by written permission from the engineer. If more than one brand is permitted by the engineer, they shall not be used alternately in any one pour. The contractor shall provide suitable means for storing cement and protecting it from dampness.

Bags of cement shall be rejected if they have become partially set or contain lumps of caked cement. The cement from rejected bags which is not partially set, caked or otherwise damaged, may be salvaged and used as bulk cement.

- B) Air-Entraining Agents - An air-entraining agent shall be added to the concrete mixture. All air-entraining agents shall be reasonably new material, thoroughly mixed and protected at all times from freezing. The air-entraining agent being used shall not be changed without permission of the engineer.

Air-entraining agents shall conform to the requirements of AASHTO M-154 (ASTM C-260).

**CONCRETE CLASS TABLE\***

	ULT DESIGN COMP STREN GTH FC 28 DAY		CEMENT CONTENT (MIN)		WATER CEMENT RATIO (MAX)	ENTRAINED AIR CONTENT (NET RANGE)	CONSISTENCY (SLUMP) (MAX) (UNLESS OTHERWISE SPECIFIED)	(APPROX) TOTAL AGGRE- GATE	(APPROX.) FINE AGGRE- GATE	(APPROX.) COARSE AGGRE-GATE
CLASS	lb/in	lb/cy		lb/lb		percent	inches	lb/cy	percent of total	percent of total
			sack		gal/sack					
A	4000	564	(6)	0.52	(5.9)	5-8	4 ½	3040	36	64
B	3500	517	(5½)	0.55	(6.2)	5-8	4 ½	3070	36	64
C	3000	470	(5)	0.60	(6.8)	5-8	4 ½	3105	37	63

\* The above Concrete Class Table proportions of cement and aggregates are for estimating purposes. The final proportions used will be determined by an Independent Laboratory Mix design from the materials furnished for the class of concrete specified.

- C) Admixtures - An admixture may be used, if advance permission is obtained from the engineer. No admixture shall be considered for approval which cannot show either certified laboratory tests results or satisfactory field performance records to substantiate any and all claims made for the product. Admixtures shall conform to ASTM C-494 or AASHTO M-194 and be limited to Types A, B, or D.
- 1) Use of calcium chloride will be permitted only upon the written approval of the engineer and then not to exceed two percent (2%) by weight of cement.
  - 2) Use of admixtures containing calcium chloride will be permitted upon written approval of the engineer and in accordance with the manufacturers' recommendations or specifications.
  - 3) Admixtures and air-entraining agents shall be added to the mix water, each agent introduced separate from the other. Under no circumstance are these agents to be combined prior to their introduction in the mixing unit.
- D) Water - Water used in mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substance injurious to the finished product. Water will be tested in accordance with and shall meet the suggested requirements of AASHTO T-26. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials. In addition the Ph shall be between 4.5 and 8.5. Neutralization by chemical additives will not be permitted.

E) Fine Aggregate for Concrete -

- 1) Fine aggregate for concrete shall conform to the requirements of AASHTO M-6 with the following exceptions:

	Max. % by Weight
Clay Lumps	1.0
Coal, Lignite or Shale	1.0
Material Passing No. 200 Sieve	4.0

The sum of the above materials and other deleterious substances such as shale, alkali, mica, coated grains, or soft and flaky particles shall not exceed four percent 4% by weight.

- 2) Grading - Fine aggregate shall be well graded from coarse to fine and shall conform to the following gradation requirements:  
For Concrete:

Passing a 3/8 inch Sieve	100%
Passing a No. 4 Sieve	95 - 100%
Passing a No. 16 Sieve	45 - 80%
Passing a No. 50 Sieve	10 - 30%
Passing a No. 100 Sieve	2 - 10%

F) Coarse Aggregate for Concrete

- 1) General - Coarse aggregates for concrete shall consist of crushed stone, gravel or other approved inert materials of similar characteristics, or combinations thereof, having strong and durable pieces. The aggregate shall be free from vegetable matter, lumps or balls of clay, adherent films of clay or other matter that would prevent thorough bonding, in accordance with the following limits.
- 2) Deleterious Substances - The amount of deleterious substances shall not exceed the following limits:

	Max % by Weight
Shale or Coal	1.0
Clay Lumps	0.5
Material Passing a No. 200 Sieve	2.0
Other deleterious substances such as friable, thin, elongated or laminated pieces	3.0

The sum of the above material and other deleterious substances shall not exceed five percent (5%) by weight.

- 3) Wear and Soundness - Coarse aggregates for concrete shall have a percentage of wear of not more than 40 when tested in accordance with AASHTO T-96 or show a sodium sulphate loss not to exceed 12 percent (12%) when tested in accordance with AASHTO T-104. The wear and soundness requirements may be waived, or modified, by the engineer provided that the coarse aggregate has a proven service record for similar service and exposure.
- 4) Grading - Coarse aggregate for concrete shall meet the following gradation limits for the concrete class specified. Other sizes or combinations of sizes may be used when specified.

Sieve Designation	Type No. 57	Type No. 67
1½	100	-



1	95-100	100
3/4	-	90-100
1/2	25-60	-
3/8	-	20-55
No. 4	*0-10	*0-10

\*Not more than five percent (5%) shall pass a No. 8 sieve.

**SECTION 501.09 - CONSTRUCTION METHODS**

A) Handling, Measuring and Batching Materials - Concrete of the classes specified shall be made up of acceptable material batched in the proportions specified by the laboratory mix design, corrections necessitated by variations in the moisture content of the component materials or for other similar reasons shall be made as directed, based upon laboratory and field determination.

The contractor may weigh or measure the water and admixtures. The cement by weight or sacks, the fine Aggregate and coarse aggregate shall be weighed.

- 1) Water - The water shall be measured either by volume or weight. The allowable error in accuracy of water measuring or weighing equipment shall not be more than .5%. The weighing equipment shall be so arranged that the accuracy of the measurement will not be affected by variations in pressure in the water supply lines. When water is measured by volume, it shall be metered through an approved water meter devise.
- 2) Cement - Cement may be measured either by weight or by sacks. A sack shall mean 94 pound bags as packed by the manufacturer. If the volume method is used, cement in all batches of concrete mixed shall be in full sacks. No batch shall be mixed using fractional sacks of cement. When cement is measured by weight, it shall be weighed on a separate scale which is accurate and maintained within a maximum tolerance of one percent (1%) of the load being weighed.
- 3) Bins and Scales - The batching plant shall be equipped with suitable bins and weighing hoppers.

The scales shall be of either the beam or springless dial type. The scales shall be so equipped and the dials so graduated that the weights of materials being weighed can be accurately determined. Scales shall be accurate to .05% throughout the range of use. Poises shall be designed to be secured in any position to prevent inadvertent change of position. Scales shall be either sealed or checked, or both, as often as the engineer deems necessary to assure their continued accuracy. For the purpose of checking scales, the contractor shall keep not fewer than ten (10) 50-pound weights at the plant site at all times.

Means of control shall be provided so that, as the quantity desired in the weighing hopper is being approached, the material may be added slowly and shut off with precision.

Batching plants may be equipped to proportion aggregates and bulk cement by automatic weighing devices of an approved type.

- 4) Batching - When batches are hauled to the mixer, bulk cement shall be transported either in waterproof compartments or between the fine and coarse aggregates. When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1 ½ hours of such contact. Sacked cement may be transported on top of the aggregates.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped cleanly into the mixer without loss. When more than one batch is carried on the truck, no spilling of material from one batch compartment into another will be allowed.

- B) Mixing - Materials for concrete shall be handled, measured and batched in accordance with Section 501.07, Composition of Concrete. Concrete shall be thoroughly mixed in a manner to positively insure a uniform distribution of the materials throughout the mass. Concrete shall be mixed only in quantities required for immediate use and shall be used within the time limits specified. Any concrete in which initial set has begun shall be wasted. Aggregates, or bags of cement, containing lumps or crusts of hardened material shall not be used.

- C) Ready Mixed Concrete - Ready-mixed concrete shall be mixed and delivered to the site of the work by means of one of the following combinations of operations.

- 1) Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in non-agitating hauling equipment (known as central-mixed concrete).
- 2) Mixed partially in a stationary mixer and the mixing completed in a truck mixer (known as shrink-mixed concrete).
- 3) Mixed completely in a truck mixer (known as transit-mixed concrete).

Mixers may be stationary mixers or truck mixers. Agitators may be truck mixers operating at agitation speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed

capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Truck mixers shall be equipped with electrically or mechanically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be actuated at the time the actual mixing is started at mixing speeds.

Truck mixers shall be loaded not to exceed the manufacturer's rated capacity. They shall combine the ingredients of the concrete into a thoroughly mixed and uniform mass and discharge the concrete with a satisfactory degree of uniformity.

When a truck mixer is used for complete mixing, each batch of concrete shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment on the metal plate on the mixer, as mixing speed. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials, including mixing water, shall be in the mixer drum before actuating the revolution counter for determination of the number of revolutions actually used for mixing.

When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed shall be allowed for partial mixing in a central plant.

Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or non-agitating hauling equipment, provided the consistency and workability is suitable for adequate placement and consolidation in place.

In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85° F. (30° C.) or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 60 minutes. When a truck mixer is used for the complete mixing of the concrete, the mixing operation shall begin within 45 minutes after the cement has been added to the aggregate. Truck agitators shall be loaded not to exceed the manufacturer's rated capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of non-agitating hauling equipment shall be so constructed that leakage of the concrete mix, or any part thereof, will not occur at any time and they shall be self-cleaning during discharge.

Concrete hauled in open-top vehicles shall be protected during hauling against access of rain or exposure to the sun for more than 20 minutes when the ambient temperature

exceeds 75 degrees F.

Additional mixing water may be incorporated into the concrete at the delivery point, upon approval of the engineer. When additional water is to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

The rate of discharge of mixed concrete from truck-mixer agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1 1/2 hours or before 300 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates.

When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 80 degrees F., or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a ticket showing volume of concrete, the weight of cement in pounds, and the total weight of all ingredients in pounds, unless otherwise ordered by the engineer. The ticket shall also show the time of day which the materials were batched and discharged.

- D. On-Site Mixed Concrete - For mixing at the site of construction or at a central point, concrete shall be mixed in a batch mixer of an approved type. No mixer having a rated capacity of less than a one-bag batch shall be used nor shall a mixer be charged in excess of its rated capacity. The batch shall be so charged into the drum that a portion of the water shall enter in advance of the cement and aggregate. 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. Mixing time shall be measured from the time all material, except water, are in the drum. Mixing time shall be not less than 60 seconds for mixers having a capacity of two cubic yards, the mixing time shall be not less than 90 seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the mixer. The volume of mixed concrete shall not exceed the mixer's normal capacity in cubic feet as shown on the A.G.C. standard rating plate on the mixer, when the mixer is operated in a level position. Any concrete mixed less than the specified time shall be discarded and disposed of by the contractor at his own expense.

## **SECTION 501.10 - HOT AND COLD WEATHER REQUIREMENTS**

- A. Cold Weather Concrete - When concrete is being placed during cold weather and the air temperature may be expected to fall below 35° F., the concrete surface shall be maintained at a temperature of not less than 50° F., for at least 72 hours.

Concrete delivered in outdoor temperatures lower than 40° F. shall arrive at the work having a temperature not less than 50° F. nor greater than 90° F.

Aggregates and mixing water shall be heated to temperature of at least 70° F., but not more than 150° F. the aggregates may be heated by either steam or dry heat. Heating equipment or methods which alter or prevent the entrainment of the required amount of air or which develop hot spots in the aggregate shall not be used.

- B. Hot Weather Requirements

- 1) In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays or other devices shall be provided as directed by the architect or engineer.
- 2) Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set or cold joints.

#### **SECTION 501.11 - PLACING**

- A. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall be placed at such a rate that it is at all times plastic and flows readily between bars. No concrete contaminated by foreign material shall be used, nor shall retempered concrete be used unless approved by the architect or engineer.
- B. When placing is started, it shall be carried on as a continuous operation until placement of the panel or section is completed.
- C. All concrete shall be thoroughly consolidated during placement. It shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms without segregation.
- D. Subgrade on which concrete is to be placed shall be moist at the time concrete is placed.

**SECTION 501.12 - CURING CONCRETE** - Immediately after forms have been removed, all concrete shall be cured by the water or impervious compound methods as described herein.

Surfaces protected by forms for five days or more will not require curing, except that unoiled wood forms shall be kept moist by sprinkling.

- A. Water Method - The concrete shall be kept continuously wet by the application of water for a minimum period of five days after the concrete has been placed.

Cotton mats, rugs, carpets, burlap, or sand blankets are to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surface shall be cleared of all curing mediums.

When concrete flat slabs are to be cured without the use of a moisture retaining medium, the entire surface of the slab shall be kept damp by the application of water with an atomizing nozzle as specified above until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than five days.

- B. Impervious Curing Compound - All surfaces shall be given the required surface finish prior to application of impervious curing compound. During the finishing period, the concrete shall be protected by the water method of curing.

The rate of application of a curing compound will be as prescribed by the engineer, with a minimum spreading rate per application of one gallon of liquid coating for 300 square feet of concrete surface. All concrete cured by this method shall receive two applications of the curing compound. The first coat shall be applied immediately after stripping of forms and acceptance of the concrete finish. If the surface is dry, the concrete shall be thoroughly wet with water and the curing compound applied just as the surface film of water disappears. The second application shall be applied after the first application has set. During curing operations, any unsprayed surfaces shall be kept wet with water.

Impervious curing compound may be white pigmented, clear or translucent.

The coating shall be protected against marring for a period of at least ten days after applications. Any coating marred or otherwise disturbed shall be given an additional coating.

When an impervious curing compound is used, the compound shall be thoroughly mixed within an hour before use.

If the use of an impervious curing compound results in a streaked or blotchy appearance, the method shall be stopped and the water curing as set out in paragraph (a) on the previous page, applied until the cause of the defective appearance is corrected.

## SECTION 501.13 TESTING -

- A. Aggregate - If required by the engineer the contractor shall, before starting concrete work, furnish representative samples of concrete aggregate proposed for use to a testing laboratory designated by the engineer and to be sampled in accordance with ASTM D-75.
- B. Standard Slump Tests - The engineer shall regularly during each day's placement check the consistency of the concrete by means of a slump test. A slump test shall also be made each time that a test cylinder is made. Slump tests shall be made in accordance with the "Method of Test for the Slump of Portland Cement Concrete," ASTM Designation C-143.
- C. Compression Tests - As required by the engineer, a set of at least four standard six-inch test cylinders shall be made and tested for every concrete placement, and one set of tests cylinders shall be made for every 100 yards of concrete or fraction thereof placed in each placement. These cylinders should be cured under laboratory conditions except that additional test cylinders cured entirely under field conditions may be required by the engineer to check the adequacy of curing and protection of the concrete. All specimens shall be taken to the engineer or engineer's representative. The engineer shall transport all specimens to the testing laboratory in a safe and approved manner. Test cylinders shall be made and laboratory cured in accordance with the standard method of making and curing concrete compression specimens in the field (ASTM C-31). Cylinders shall be tested by an independent testing laboratory, as approved by the engineer, and all charges made for testing cylinders shall be paid for by the owner.

Of each of the four cylinders taken for a pour, two shall be tested for strength at seven days and two tested for strength at 28 days. To conform to the requirements of this specification, the average of any three consecutive strength tests of the laboratory-cured cylinders representing each class of concrete shall be equal to or greater than the specified strength and not more than 20% of the strength tests shall have values less than the specified strength. A test shall consist of two cylinders broken at 28 days.

When concrete fails to conform to the requirements above or when tests of field-cured cylinders indicate deficiencies in protection and curing, the owner's representative may order tests on the hardened concrete as described in the ACI Building Code (ACI 301) for that portion of the structure where the questionable concrete has been placed.

Compensation will be allowed for load tests or coring. In the event the load or core tests indicate that the structure is unsatisfactory, the contractor shall, at his own expense, make such modifications as required by the engineer to make the structure sound.

- D. Air Content Tests - The engineer shall regularly during each day's placement, check the air content by either the "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" (ASTM C-231) or "Method of Test for Air Content of Freshly

Mixed Concrete by the Volumetric Method" (ASTM C-173). An air content test shall also be made by the engineer each time a compression test cylinder is made.

- E. Unit Weight Test - Each time a compression test cylinder is made, a unit weight test shall be made in accordance with ASTM C-138.



CITY OF LANDER, WYOMING  
STNADARDS & SPECIFICATIONS  
SECTION 502  
REINFORCING STEEL

**SECTION 502  
REINFORCING STEEL**

**SECTION 502.01 - DESCRIPTION -**

This work shall consist of furnishing and placing reinforcing steel in accordance with these specifications and in conformity with the plans.

**SECTION 502.02 - MATERIALS -**

Reinforcing steel shall meet the following requirements:

- A) Reinforcing steel for concrete reinforcement shall meet the requirements of ASTM A-615. Bars other than ties and stirrups shall conform to Grade 60. Ties and stirrups shall conform to Grade 40.
- B) Spiral reinforcement shall conform to ASTM A-82.
- C) Fabricated Steel Bar or Rod Mats for Concrete Reinforcement, AASHTO M-54 (ASTM A-184) for deformed, intermediate grade new billet steel, either clipped or welded mats.
- D) Welded wire fabric for concrete reinforcement, AASHTO M-55 (ASTM A-185).
- E) Dowel bars for rigid pavement expansion joints or devices, AASHTO M-183 (ASTM A-36). They shall be plain and free from burring or other deformations that would restrict slippage in the concrete. One half the length of the bar shall be painted with one coat of lead or tar paint.
- F) Sleeves for dowel bars shall be metal of an approved design to cover two inches (2"), plus or minus 1/4 inch, of the dowel, with a closed end with suitable stop to hold end of the sleeve at least one inch (1") from the end of the dowel bar. Sleeves shall be of such design that they do not collapse during construction.
- G) All bars shall be properly bundled and tagged with weather-resistant tags.

All reinforcing shall be subject to testing by the engineer prior to its use. If the steel furnished fails to meet the test requirements, it shall be replaced with acceptable material at the contractor's expense.

The contractor shall flame or saw cut two 3'6" long samples of each Grade 60 bar size used from the steel delivered to the job site at locations selected by the engineer. He shall furnish and install a straight splice bar from the same lots or heats as the other reinforcing steel to replace each test sample cut. The length of the straight splice bars shall be as required below:

<u>Size</u>	<u>Length</u>	<u>Size</u>	<u>Length</u>
#4	7'-0"	#8	10'-6"
#5	7'-11"	#9	11'-5"
#6	8'-9"	#10	12'-5"
#7	9'-8"	#11	13'-5"

The contractor shall furnish one test sample of each size of spiral wire, Grade 40 bars and bars larger than #11 used. These test samples shall be 3'-6" long and shall be accompanied to the project with a certification that they are from the same heat as the same size of bar or spiral wire furnished from the project.

All test samples, splice bars to replace test samples and certifications shall be furnished by the contractor at his expense.

### **SECTION 502.03 - PROTECTION OF MATERIALS -**

Reinforcing steel shall be protected at all times from damage. When placed in the work, the reinforcing steel shall be free from dirt, detrimental scale, paint, oil or other foreign substances.

Rust, if tight, will not be considered objectionable; however, any reinforcing steel which has become rusted to such an extent as to impair its efficiency shall be replaced at the contractor's expense. All cement mortar that has adhered to projecting steel because of previous placement shall be removed.

### **SECTION 502.04 - BENDING -**

Unless otherwise permitted, all reinforcing bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as shown on plans or as permitted. Only competent men shall be employed for cutting and bending and proper appliances shall be provided for such work. Should the engineer approve the application of heat for field bending reinforcing bars, precautions must be taken to assure that the physical properties of the steel will not be materially altered.

Reinforcing bars for bending and hooks shall be fabricated in accordance with the current edition of the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" by the American Concrete Institute. All dimensions shown in bending diagrams on plans are measured out-to-out except for 135 degree and 180 degree hooks.

Spirals shall be furnished with one and one-half (1 1/2) extra turns at each end to provide anchorage. Standard channel spacers shall be furnished with each spiral to hold the bar firmly in place during placing of concrete. The number of spacers used shall be as follows:

Core Diameter, 20 inches or less	2 spacers
Core Diameter, 21 to 30 inches	3 spacers
Core Diameter, greater than 30 inches	4 spacers
All 5/8" spiral bars, regardless of core diameter	4 spacers

**SECTION 502.05 - PLACING AND FASTENING -**

All reinforcing steel shall be accurately placed and during the placing of concrete, firmly held by approved supports in the position shown on the plans. Reinforcing bars shall be securely fastened together by tying at all intersections with No. 14 or No. 16 wire except where the spacing is less than one foot (1') in each direction, in which case alternate intersections shall be tied. Fastening of reinforcing steel by tack welding will not be permitted.

All dimensions shown on the plans for spacing of steel shall apply to centers of bars unless otherwise noted.

Unless otherwise permitted, reinforcing steel shall not be placed by inserting in concrete in place.

Unless otherwise approved in writing, all reinforcing steel shall be furnished in the full lengths shown on the plans and no splicing will be permitted except where splice bars are used to replace test samples.

Splices that are permitted, or required for test samples, shall be lapped at least 42 diameters and shall be well distributed or located at points of minimum tensile stress. Splice bars shall be rigidly wired together except that where bars are offset from each other, wiring may be omitted if the bar ends are satisfactorily held in proper position. Splices in spiral reinforcement, when approved, shall be made with a lap of one and one-half (1 1/2) turns.

When splices are made by butt welding, a joint efficiency of 100 percent (100%) shall be obtained. The bar shall be preheated and then welded using low-hydrogen electrodes. Welding operators shall be prequalified and procedures shall be in accordance with current AWS D 12.1.

Welded wire fabric ends and sides shall overlap no less than one mesh and shall be fastened by wires at not to exceed one-foot intervals.

Bundled bars shall be tied together at no greater than six foot (6') centers.

Metal chairs, bolsters or other metal supports that are in contact with the exterior surface of the concrete shall be galvanized.

To hold reinforcing bars in position, precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires and other approved devices of sufficient strength to resist crushing under applied loads shall be used. Wooden, aluminum and plastic supports shall not be used.

Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 503  
CONCRETE CURB, GUTTER AND SIDEWALK**

**SECTION 503**  
**CONCRETE CURB, GUTTER AND SIDEWALK**

**SECTION 503.01 - GENERAL -**

All concrete curb, gutter and sidewalk construction within the City of Lander street system or for future acceptance into the City of Lander street system shall be installed in accordance with these specifications.

**SECTION 503.02 - ENGINEERING PLANS -**

Concrete curbs, gutters and sidewalks shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City Engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 503.03 - LICENSES AND PERMIT REQUIRED -**

All construction shall be performed by a licensed and bonded general contractor, except a homeowner may construct his own sidewalk. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 503.04 - INSPECTION AND TESTING -**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 503.05 - WARRANTY OF WORK -**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous conditions at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four hours and complete such work within twelve hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City at its option may have such repairs made and invoice the contractor for the actual cost of repair.

#### **SECTION 503.6 - DESCRIPTION -**

- A. General - Curbs, gutters and sidewalks shall consist of air entrained and water reduced Type II Portland Cement concrete constructed on a prepared subgrade in accordance with these specifications. This work shall be in reasonably close conformity with the lines and grades, thicknesses and typical cross sections shown on the plans or established by the engineer. The curb, gutter and sidewalk may be placed monolithically, separately or the curb and gutter alone.
- B. Wheelchair ramps, curb and sidewalks shall be constructed with wheelchair curb ramps at all points of intersection between pedestrian and motorized lanes of travel and no less than two (2) curb ramps per lineal block. Curb ramps will be one of the types shown in Standard Drawings 504-03 through 504-05.

#### **SECTION 503.07 - MATERIALS -**

- A. Portland Cement Concrete - Portland Cement Concrete shall be made from Type II Portland Cement, unless otherwise specified or approved by the City Engineer and conform to the requirements of Section 501. The design shall be a six (6) sack mix with twelve (12) ounces of water reducing admixture per cubic yard.
- B. Reinforcing Steel - Reinforcing steel shall conform to the requirements of Section 502 - REINFORCING STEEL.
- C. Pre-Formed Expansion Joint Material - Joint material shall comply with the requirements of AASHTO M-213, ASTM-994, ASTM D-1751, or ASTM D-1752.

#### **SECTION 503.08 - SUBGRADE PREPARATION -**

The subgrade shall be excavated or filled with a bed course material as specified in Section 607A.13 to the required grades and lines. All soft, yielding and otherwise unsuitable materials shall be removed and replaced with suitable material. Filled sections shall be compacted to not less than 90% of the maximum density and extend a minimum of one foot (1') outside the form lines. The subgrade shall be reasonably dense, firm, trimmed to a uniform smooth surface and in a moist condition when the concrete is placed. No concrete placement will be allowed on a spongy or frozen subgrade.

#### **SECTION 503.09 - CONCRETE PLACEMENT -**



The concrete shall be placed either by an approved slipform/extrusion machine, by the formed method, or by the combination of these methods.

- A. Machine Placement - The slipform/extrusion machine approved shall be so designed as to place, spread, consolidate, screed and finish the concrete in one complete pass in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous concrete section. The machine shall shape, vibrate and/or extrude the concrete for the full width and depth of the concrete section being placed. It shall be operated with as nearly as continuous forward movement as possible. All operations of mixing, delivery and spreading concrete shall be so coordinated as to provide uniform progress, with stopping and starting of the machine held to a minimum.
- B. Formed Method - The forms shall be of wood, metal or other suitable material that is straight and free from warp, having sufficient strength to resist the pressure of the concrete without displacement and sufficient tightness to prevent the leakage of mortar. Flexible or rigid forms of proper curvature may be used for curbs having a radius of 100 feet or less. Division plates shall be metal.

The front and back forms shall extend for a full depth of the concrete. All of the forms shall be braced and staked so that they remain in both horizontal and vertical alignment until their removal. They shall be cleaned and coated with an approved form-release agent before concrete is placed against them.

The concrete shall be deposited into the forms without segregation and then it shall be tamped and spaded or mechanically vibrated for thorough consolidation. Low roll or mountable curbs may be formed without the use of a face form by using a straightedge and template to form the curb face.

When used, face forms shall be removed as soon as possible to permit finishing. Front and back forms shall be removed without damage to the concrete after it has set.

#### **SECTION 503.10 - FINISHING -**

The plastic concrete shall be finished smooth, if necessary, by means of a wood float and then it shall be given a final surface texture using a light broom or burlap drag. Concrete that is adjacent to forms and formed joints shall be edged with a suitable edging tool to the dimensions shown on the plans.

#### **SECTION 503.11 - JOINTING -**

- A. Contraction Joints - Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding ten feet on curb and gutter or monolithic curb, gutter and sidewalk. Joint depth shall have a minimum depth of 3/4". Contraction joint intervals on separately formed sidewalks shall not exceed five feet.

Contraction joints may be sawed, hand formed or made by 1/8 inch thick division plates in the form work. Sawing shall be done early after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed either by (1) using a narrow or triangular jointing tool or a thin metal blade to impress a plane of weakness into the plastic concrete, or (2) inserting 1/8 inch thick steel strips withdrawn before final finishing of the concrete. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set and while the forms are still in place.

- B. Expansion Joints - Expansion joints shall be constructed at right angles to the curb line at immovable structures and at points of curvature for short-radius curves. Filler material for expansion joints shall conform to requirements of AASHTO M-213, ASTM D-994, D-1751 or D-1752 and shall be furnished in a single 1/2 inch thick piece for the full depth and width of the joint.

Expansion joints in a slip formed curb and gutter or curb, gutter and sidewalk shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. The cut shall be only wide enough to permit a snug fit for the joint filler.

After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then troweled and edged.

Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb, gutter and sidewalk immediately, installing temporary holding forms, placing the expansion joint filler and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discarded.

- C. Other Jointing - Construction joints may be either butt or expansion type joints. Curbs and gutters constructed adjacent to existing concrete shall have the same type of joints as in the existing concrete, with similar spacing' however, contraction joint spacing shall not exceed ten feet.

#### **SECTION 503.12 - PROTECTION -**

The contractor shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of water proof paper or plastic sheeting. For slipform construction, materials such as wood planks or forms to protect the edges shall also be required.

Hot and cold weather protection shall be in accordance with Section 501.10 HOT AND COLD WEATHER REQUIREMENTS.

#### **SECTION 503.13 - CURING -**

Curing shall be in accordance with Section 501.12, CURING CONCRETE.

**SECTION 503.14 - BACKFILLING -**

After the concrete has set sufficiently, the spaces in front and back of curbs shall be refilled with suitable material to the required elevations. The fill material shall be thoroughly tamped in layers.

**SECTION 503.15 - TOLERANCES -**

The work shall be performed in a manner which results in a curb, gutter and sidewalk constructed to specified line and grade, uniform in appearance and structurally sound. Curb, gutter and sidewalk found with unsightly bulges, ridges, low spots in the gutter or other defects shall be removed and replaced at the contractor's expense if the engineer considers them to be irreparable. When checked with a ten foot (10') straightedge, grade shall not deviate more than ¼ inch and alignment shall not vary more than ½ inch.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 504  
CONCRETE DRIVEWAY APPROACHES,  
CURB TURN FILLETS, VALLEY GUTTERS  
AND MISCELLANEOUS NEW  
CONCRETE CONSTRUCTION**

**SECTION 504**  
**CONCRETE DRIVEWAY APPROACHES, CURB TURN FILLETS,**  
**VALLEY GUTTERS AND MISCELLANEOUS NEW**  
**CONCRETE CONSTRUCTION**

**SECTION 504.01 - GENERAL**

All concrete driveway approaches, curb turn fillets, valley gutters and miscellaneous concrete construction within the City of Lander street system or for future acceptance into the City of Lander street system shall be installed in accordance with these specifications.

**SECTION 504.02 - ENGINEERING PLANS**

Concrete driveway approaches, curb turn fillets, valley gutters and miscellaneous work shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 504.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 504.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 504.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The contractor shall maintain backfill in a satisfactory condition, all areas showing signs of settlement shall be filled and maintained for a period of one year following the date of final acceptance. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

The contractor, upon notification by the City of needed emergency repairs, shall start such work within four (4) hours and complete such work within twelve (12) hours of said notification by telephone. If repairs are not started or completed within the above time limits, the City at its option may have such repairs made and invoice the contractor for the actual cost of repair.

#### **SECTION 504.06 - DESCRIPTION**

This section covers concrete driveway approaches, curb turn fillets, valley gutters, new monument boxes and all other miscellaneous new concrete construction, complete in place. See Standard Drawings 504-01, 504-02, 504-03, 504-04, and 504-05.

#### **SECTION 504.07 - MATERIALS**

- A. PORTLAND CEMENT CONCRETE - Air-entrained Portland Cement shall conform to the requirements of SECTION 501, Portland Cement Concrete and shall be six (6) sack mix with twelve (12) ounces of water reducing admixtures per cubic yard.
- B. REINFORCING STEEL - Reinforcing steel shall conform to the requirements of SECTION 502 - Reinforcing Steel.
- C. PRE-FORMED EXPANSION JOINT MATERIAL - Joint material shall comply with requirements of AASHTO M-213, ASTM D-994, ASTM D-1751 or ASTM D-1752.

#### **SECTION 504.08 - CONSTRUCTION METHODS - DRIVEWAY APPROACHES, CURB TURN FILLETS AND VALLEY GUTTERS**

- A. GENERAL - Driveway approaches, either new or replacement, valley gutters and curb turn fillets shall be constructed at the locations shown on the plans and where directed by the engineer and shall be in accordance with these specifications and plans.
- B. SUBGRADE PREPARATION - The subgrade shall be excavated or filled with suitable material to the required grades and lines. All soft, yielding and otherwise unsuitable material shall be removed and replaced with suitable material. Filled sections shall be compacted and extend a minimum of one foot (1') outside the form lines. The subgrade shall be reasonably dense, firm, trimmed to a uniform smooth surface and in a moist condition when the concrete is placed. No concrete placement will be allowed on spongy or frozen subgrade.
- C. ERECTING FORMS - Forms of wood or steel, shall be staked securely in place, true to line and grade.

Sufficient support shall be given to the form to prevent movement in any direction, resulting from the weight of the concrete or the concrete placement. Forms shall not be set until the subgrade has been compacted within one inch (1") of the established grade. Forms shall be clean and well oiled prior to setting in place. When set, the top of the form shall not depart from grade more than one-quarter inch (¼") when checked with a ten foot (10') straightedge. The alignment shall not vary more than one-half inch (½") in ten feet (10'). Immediately prior to placing the concrete, forms shall be carefully inspected for proper grading, alignment and rigid construction. Adjustments and repairs as needed shall be completed before placing concrete.

- D. **THICKNESS AND REINFORCING** - Concrete valley gutters and curb turn fillets shall be a minimum of six (6) inches in thickness.
- E. **PLACING CONCRETE** - The subgrade shall be properly compacted and brought to specified grade before placing concrete. The subgrade shall be thoroughly dampened immediately prior to the placement of the concrete. Concrete shall be spaded and tamped thoroughly into the forms to provide a dense, compacted concrete free of rock pockets. The exposed surfaces shall be floated, finished and broomed.

The rate of concrete placement shall not exceed the rate at which the various placing and finishing operations can be performed in accordance with these specifications.

- F. **STRIPPING FORMS AND FINISHING**

- A. Forms may be removed at such time as the concrete is sufficiently set that removal will be without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth, or sprayed with curing compound. All forms shall be cleaned, oiled and be examined for defects before they are used again.

- B. **BROOMED FINISH** - The surface of concrete shall be finished true to the lines and grades shown on the plans. Concrete shall be worked until the coarse aggregate is forced down into the body of the concrete and no coarse aggregate is exposed. The surface shall then be floated with a wooden float to a smooth and uniform surface. When the concrete has hardened sufficiently, the surface shall be given a broom finish. The broom shall be of an approved type. The strokes shall be square across the concrete from edge to edge with adjacent strokes overlapped. Strokes shall be made without tearing the concrete. The broomed finish shall produce regular corrugation not over one-eighth inch (1/8") in depth.

- G. **PROTECTION** - The contractor shall always have materials available to protect the surface of the plastic concrete against rain. These materials shall consist of waterproof paper or plastic sheeting. For slipform construction, materials such as wood planks or

forms to protect the edges shall also be required.

Hot and cold weather protection shall be in accordance with Section 501.10 Hot and Cold Weather Requirements.

H. CURING - Curing shall be in accordance with SECTION 501.12 Curing Concrete.

I. JOINTS

A. Preformed Expansion Joints shall be installed at the locations shown in the standard details and at point of curvature for short-radius curves.

B. Contraction joints shall be provided between expansion joints at the intervals noted in the standard details.

J. TOLERANCES - The work shall be performed in a manner which results in the item being constructed true to line and grade, uniform in appearance and structurally sound. Items found with unsightly bulges, ridges, low spots or other defects shall be removed and replaced at the contractor's expense if the engineer considers them to be irreparable. When checked with a ten foot (10') straightedge, grade shall not deviate by more than one-quarter inch ( $\frac{1}{4}$ " ) and alignment shall not vary by more than one-half inch ( $\frac{1}{2}$ " ).

New monument boxes, new street light bases and other miscellaneous concrete construction shall be constructed in accordance with the detail drawings.



**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 601  
EARTHWORK**

## **SECTION 601 EARTHWORK**

### **SECTION 601.01 - GENERAL**

All earthwork construction within the City of Lander or for future acceptance into the City of Lander shall be installed in accordance with these specifications.

### **SECTION 601.02 - ENGINEERING PLANS**

All earthwork shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City engineer. Plans shall conform with the City of Lander minimum design standards.

### **SECTION 601.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded general contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing constructing. The City engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

### **SECTION 601.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the contractor, if the material or work is found deficient, or by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

### **SECTION 601.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. When the developer or contractor is notified by the City that any backfill is hazardous he shall correct such hazardous condition at once.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City engineer.

### **SECTION 601.06 - CLEARING**

A. Description - This item shall consist of the removal and disposal of trees, stumps, brush,

vegetation and other objectionable matter occurring within the clearing limits or which interfere with grading and embankment.

- B. Construction Methods - All areas between lines 2.0 feet outside the back of sidewalk, curb and/or curb and gutter, or within the neat lines of cut or fill areas, including alleys, shall constitute the clearing limits. Where sidewalk, curb and/or curb and gutter is not required, the clearing limits shall be 2.0 feet outside the edge of pavement or within the neat lines of cut or fill areas.

Unless specifically designated to be saved and marked as such, all trees, stumps, brush, windfalls, logs and other objectionable matter occurring within clearing limits shall be marked, cut off and disposed of. All stumps within the clearing limits and all trees, the stumps of which are not to be grubbed, shall be cut not more than twelve inches (12"), above the ground.

The refuse resulting from the clearing operation may be hauled to an available waste site secured by the Owner and shall be disposed of in such a manner as to meet all requirements of state, county and municipal regulation regarding health, safety and public welfare. When authorized by the proper fire authorities, the contractor may dispose of such refuse by burning on the site of the project provided all requirements set forth by the authorities are met.

On easements through private property, the contractor shall not burn on the site unless specifically permitted by the property owner in which case he shall obtain permission as previously stated.

In all cases, the authority to burn shall not relieve the contractor in any way from damages which may result from his operations. In no case shall any material be left on the project, shoved onto abutting private properties, or be buried in embankments or trenches on the project.

The contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing on areas outside of the grading area, or on parking strips or adjacent lots.

## **SECTION 601.07 - GRUBBING**

- A. Description - This item shall consist of the excavation, removal and disposal of roots, stumps, stubs together with duff, matted roots and buried debris from the grubbing limits.
- B. Construction Methods - All areas between lines 2.0 feet outside the back of sidewalk, curb and/or curb and gutter, or two feet outside the edge of pavement where sidewalk, curb and/or curb and gutter is not required and all areas within the neat lines of cuts and all areas to be covered by embankments less than three feet (3') in height, including alleys,

shall constitute the grubbing limits.

All stumps, roots, logs or other timber more than three inches (3") in diameter and all brush, matted roots and other debris within the grubbing limits not suitable for street foundation shall be pulled or otherwise removed to a depth of not less than six inches (6") below the original ground to twelve inches (12") below street subgrade.

All material resulting from the grubbing operations shall be disposed of as specified in Section 601.06 CLEARING. All depressions below street subgrade, or below the final surface of the ground resulting from the grubbing operations, shall be backfilled with suitable material.

## **SECTION 601.08 - STREET AND DRAINAGE EXCAVATION**

A. Description - This item shall consist of performing all operations necessary to excavate and satisfactorily dispose of all material of whatever character as shown on the plan or as staked by the engineer. All material excavated shall be defined as "Unclassified Excavation Above Subgrade."

B. Construction Methods

1. Grading and Disposal of Surplus and Waste Material - Where the ground foundation for embankments is composed of muck and other unstable materials, such material shall be removed to the depth of at least two (2) feet or as directed by the engineer and satisfactorily disposed of.

This excavation shall extend to the same lines as Section 601.07 GR GRUBBING, and also as shown on City of Lander Standard Drawings No. 609-01-02-03-04, or as directed by the engineer.

2. Maintenance of Subgrade and Drainage - During the construction of the street improvement, the subgrade shall be maintained in such a condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments shall be so constructed as to avoid damage to embankments by erosion.

If it is necessary in the prosecution of the work to interrupt existing surface drainage, sewer or underdrainage, temporary drainage facilities shall be provided and maintained at the contractor's expense until permanent drainage facilities are completed. The contractor shall be responsible for and shall take all necessary precautions to protect and preserve any and all existing tile drains, sewers or other subsurface drains, conduits, gas mains and other underground structures or parts thereof which may be affected by the operations in the contract and which in the opinion of the engineer may be properly continued in use without any change. The contractor shall, at his own expense, satisfactorily repair all damage to such facilities or structures which may result from any of his operations or

from his negligence during the period the contract is in force.

3. Compaction in Excavated Areas - The top six inches (6") of subgrade or as otherwise designated on the plans in excavated areas which are to be paved or covered with sidewalk, curb and gutter shall be compacted to a density as specified in Section 601.09, Embankment, paragraph D, Density Requirements.

#### SECTION 601.09 – EMBANKMENT

- A. Description - "Embankment" shall consist of the construction of fills, placing of miscellaneous backfills, within or without the areas between sidewalks, curbs, to the lines, grades, dimensions and typical section shown on the plans and/or as designated by the engineer.
- B. Material - Embankments shall be constructed from suitable material taken from the designated excavation in conformity with the lines, grades and cross-section shown on the plans. Stumps, trees, rubbish, vegetation, frozen lumps or other unsuitable materials shall not be placed in embankments.
- C. Construction Methods - When embankments are to be placed on a hillside, or where new fill is to be placed against existing embankment, the slope of the original hillside, or old fill respectively, shall be benched or stepped by cutting into it horizontally, for a minimum distance of twelve inches (12") to provide for secure bonding of the embankment while it is being brought up in layers. Each bench shall be cut as close to the one below as the slope of the ground will permit. Material thus cut out of the benches shall be incorporated into the new fill at the contractor's expense.

If it should become necessary, because of weather or other conditions, to suspend grading operations, the entire area worked upon shall be bladed until smooth, free of depressions and ruts, and crowned so that no water can collect or be impounded.

Embankment placed adjacent to structures shall be brought up in equal layers on all sides to prevent distortion of any of these parts. Areas inaccessible to tamping rollers or power rollers shall be compacted by hand or mechanical tampers or other means until the density conforms to adjacent embankment, in accordance with these specifications.

Embankment material shall be placed in uniform approximate horizontal layers not to exceed eight inches (8") in loose thickness, for the entire width of the embankment. Each layer of embankment shall be completed, leveled and compacted before the succeeding layer is placed.

Embankment which has been subjected to freezing shall be refinished to grade,

cross section and compaction requirements after the frost is out of the ground and the embankment is in suitable condition for work.

- D. Density Requirements - The contractor shall provide watering and rolling as required to obtain the density of 95% of maximum dry density for all the embankment placed and no separate pay compensation shall be allowed for rolling and watering other than the earthwork bid item or items listed on the proposal. In the case of embankment material with Plasticity Indexes greater than zero, as determined by ASTM D-424, the amount of water required for rolling shall be within plus two percentage points of optimum moisture content as determined by AASHTO T-99.

Tests for laboratory and field densities shall be performed in accordance with Section 601.10, Compaction Control Test, below.

### **SECTION 601.10 - COMPACTION CONTROL TESTS**

- A. Description - This specification shall govern the determination of the maximum density, field density and percent compaction of those materials for which a minimum percent compaction is specified. It covers the basic procedure to be followed in performing the test for maximum density and describes several procedures that may be used to determine the field density and percent compaction.

In all cases density shall be started as the dry weight in pounds per cubic foot.

- B. Maximum Density - Maximum density is defined as the maximum dry weight in pounds per cubic foot obtained when a material is mixed with different percentages of water and compacted in a standard manner. The percentage of water at which maximum density is obtained is termed the optimum moisture content.
- C. Laboratory Compaction Tests - The maximum density shall be determined by the appropriate method shown below:
1. Where all of the material passes a No. 4 Sieve, use AASHTO T-99, Method A (or B).
  2. Where the material contains particles larger than a No. 4 Sieve, use AASHTO T-99, Method C (or D).
  3. Where the material contains particles larger than 3/4 inch follow the replacement procedure given in the note under Method C of AASHTO T-99.
- D. Field Density - Field density refers to the dry density expressed in pounds per cubic foot of a layer of compacted material in place at the site as determined by a sample representative of the compacted layer.

The field density shall be determined in accordance with AASHTO T-147, AASHTO T-181, ASTM D-1556, ASTM D-2922 or other methods approved by the engineer.

- E. Percent Compaction - The percent compaction is defined as the density of the compacted layer expressed as a percentage of the maximum density of the material when tested in accordance with these specifications.

The percentage of compaction is computed by the formula:

$$\text{Percent Compaction} = \frac{\text{Field Density}}{\text{Maximum Density}} \times 100$$

### **SECTION 601.11 - BORROW EXCAVATION DEFINED**

"Borrow Excavation" shall consist of excavation made from borrow areas within the project limits and outside the normal grading limits for the completion of embankments.

Borrow areas or areas within the project limits from which the borrow may be obtained will be designated on the plans.

Borrow excavation shall be made only at those designated located and within the horizontal and vertical limits as stated or directed. On completion of borrow operations, the borrow area will be adequately drained and finished to a neat and uniform grade acceptable to the engineer.

The borrow excavation shall be handled and placed as specified in Section 601.09, Embankment.

### **SECTION 601.12 - IMPORTED BORROW EXCAVATION DEFINED**

"Imported Borrow Excavation" shall consist of excavation made from borrow areas outside the project limits and outside the normal grading limits for the completion of the embankments.

Borrow areas or areas outside the project pits from which the imported borrow may be obtained will be designated. However, any source chosen by the contractor will be subject to the approval of the engineer.

The Imported Borrow Excavation shall be handled and placed as specified in Section 601.09, Embankment.

- A. Description - After the earthwork has been substantially completed and after all underground utilities, manholes, catch basins, valve boxes, etc., have been installed or adjusted to grade, the subgrade shall be brought to the lines, grades and cross sections shown on the plans and compacted to the required density.
- B. Construction Methods - All soft and unstable material and other portions of the subgrade

which, in the opinion of the engineer, cannot be compacted satisfactorily shall be removed to lines and grades as directed by the engineer.

All boulders appearing in the earth excavation shall be removed or broken off to a depth of not less than four inches (4") below subgrade. All rock sections shall be brought to grade by depositing a satisfactory cushion material to a depth authorized by the engineer.

If the surface of an old stone or gravel roadbed conforms approximately to the surface of the finished subgrade, such sections shall be scarified superficially for the full width of the subgrade to a depth sufficient to eliminate all depressions and to permit uniform reshaping and compaction.

At all times ditches and drains along the subgrade shall be so maintained as to drain effectively. When ruts of two inches (2") or more in depth are formed, the subgrade shall be brought to grade and if necessary be reshaped and rerolled. In no case shall any surface course or pavement be placed on a frozen or muddy subgrade. The top six inches (6") of the subgrade shall have a minimum compacted density as is specified for "Embankment".

In addition, the finished grade shall not deviate more than one-tenth foot (1/10') as to any point from the staked elevation. Until the subgrade has been checked and approved, no surface course or pavement shall be laid thereon. Under the square yard method of measurement and payment the contractor has the option of deviating from the above tolerances as long as the specified base course section and profile is maintained.

Base course material meeting the specified gradation and thickness shall be placed on the prepared subgrade and compacted in six inch (6") layers to the minimum compacted density as is specified for "Embankment".

Grades shall be constructed to those shown on the plans or as directed by the engineer. The fill areas shall be compacted to not less than 90% of maximum density or equal to the density or equal to the density of undisturbed adjacent material, whichever is greater. The contractor shall use borrow or fill material reasonably free of refuse, stumps, broken concrete and large rocks.



CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 603  
WATERING

SECTION 603  
WATERING

**SECTION 603.01 - DESCRIPTION**

This item shall consist of furnishing and applying water required in the compaction of embankments, subgrades, base courses and surface course, in accordance with the requirements of these specifications.

**SECTION 603.02 - CONSTRUCTION METHODS**

Water, when required, shall be applied at the locations and in the amounts required to properly compact the work. An adequate water supply shall be provided by the owner. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.

In the watering of subgrades and embankments, the engineer may direct the contractor to apply water in such quantities that the subgrade and embankment shall be compacted at a moisture content in excess of "optimum moisture." When so directed, the amount of water required in excess of "optimum moisture" will not be greater than two percent (2%).

The contractor shall also apply water during the course of the work to control dust, maintaining all embankment and base courses in a damp condition.

**SECTION 603.03 - USE OF CITY WATER**

Water required for compaction of embankments, subgrade and gravel courses may be obtained from the City Water Department, or from other sources as designated by the engineer.

CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 604  
REMOVAL OF EXISTING PAVEMENT,  
CONCRETE CURB, SIDEWALK, DRIVEWAY  
AND/OR STRUCTURES

**SECTION 604**  
**REMOVAL OF EXISTING PAVEMENT, CONCRETE CURB,**  
**SIDEWALK, DRIVEWAY AND/OR STRUCTURES**

**SECTION 604.01 - DESCRIPTION**

The work involved in this category shall consist of removing and satisfactorily disposing of existing pavement, concrete curb, combined curb and gutter, sidewalk, private driveways, crosswalks and any structures designated on the plans or as specified in these specifications.

**SECTION 604.02 - CONSTRUCTION METHODS**

All existing pavement, concrete curb, crosswalk and/or combined curb and gutter which is specified for removal on the plans or as directed by the engineer, shall be removed and disposed of by the contractor. Care shall be exercised in such removal to assure that adjacent facilities or structures which are to remain shall not be disturbed. Any damage to such existing facilities or structures resulting from carelessness or negligence on the contractor's part shall be satisfactorily restored to its original condition at the contractor's expense.

Existing pavement shall be cut and removed to the lines indicated on the plans, or as directed by the engineer. The cut shall be made in a vertical plan by sawing, roller blade or jack-hammering. Drop blades are not acceptable.

Existing private concrete driveways or sidewalks which interfere with construction of street improvements which do not match for grade shall be removed as shown on the plans or as directed by the engineer. Removal shall be on a neat lines produced by a concrete saw cut.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 605  
ADJUSTING EXISTING MANHOLES, LAMPHOLES,  
INLETS, WATER VALVE BOXES, WATER SERVICES  
AND FIRE HYDRANTS TO GRADE**

**SECTION 605**  
**ADJUSTING EXISTING MANHOLES, LAMPHOLES, INLETS,**  
**WATER VALVE BOXES, WATER SERVICES AND**  
**FIRE HYDRANTS TO GRADE**

**SECTION 605.01 - DESCRIPTION**

This item shall consist of locating and adjusting to grade existing manholes, lampholes, inlets, water valve boxes or services and fire hydrants as shown on the plans and as required in the Special Provisions. See Standard Drawings 605-01 and 605-02.

**SECTION 605.02 - MATERIAL**

All material such as concrete brick and mortar shall meet specifications as required in the section on the particular material involved, or if the material is not covered in these specifications, the material used for adjusting shall be equal and comparable to that in the existing structure. If extensions for water valve boxes or services and fire hydrants are required beyond the length found to exist, they shall be comparable to that in the existing structure.

**SECTION 605.03 - METHOD OF CONSTRUCTION**

All existing manholes, inlets, lampholes and water valve boxes or services shall be brought to grade by either lowering or raising as required in accordance with the details shown on the plans. Where lowering of manholes, lampholes or inlets is required, care shall be used in removing the top portion of the masonry or pipe. Before the ring and cover is replaced, the top of the masonry on the manhole, lamphole or inlet must be true to line and grade.

Water valve boxes and services shall be excavated and exposed so as to readily determine whether height adjustment can be made without substituting a longer section. Water valve boxes and services shall be adjusted laterally to be centered and plumb over the operating nut and so the valve stem can be operated by the extension. Tops of valve boxes shall be set flush with street surfacing or sidewalks/curb in the case of fire hydrant valves. Water services shall be adjusted by raising or lowering the curb key stop or extension box as specified in the special provisions or as shown in the plans.

Manholes, lampholes and water valve boxes shall be adjusted to final grade before the seal coat is applied. Preliminary adjustment may be required to allow placing of base courses and paving over the manhole, lamphole or water valve.

Backfill shall be in conformance with Section 601.08, Street and Drainage Excavation, Part B, Construction Methods. There may be adjustments required in the horizontal location of some existing fire hydrants. At the time of construction staking, any hydrants which require horizontal adjustment will be located by the Engineer and the adjusted location will be staked by the engineer as shown on the plans.

All fire hydrants shall stand plumb with the pumper nozzle facing the street and at least six inches (6") behind the sidewalk. Hydrants shall be set with the ground line at the location indicated by the hydrant manufacturer. Hydrants shall be set in line with intersecting property lines, unless otherwise directed by the engineer.

Before final acceptance, all manholes, lampholes, inlets and water valve boxes or services shall be cleaned and water valve boxes or services and fire hydrants shall be operational.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 607A  
AGGREGATES**



## **SECTION 607A AGGREGATES**

### **SECTION 607A.01 - DESCRIPTION**

When crushed aggregate for sub-base, bases, surfacing or bituminous pavements is specified, all boulders in the pit up to six inches (6") in diameter shall be crushed to meet the required specifications and shall be uniformly distributed in the remainder of the material, unless otherwise specified on the plans.

Unless otherwise provided for in the special revisions, gradation requirements, as listed herein, shall be the percentage of material by weight passing laboratory sieves having square openings. Sieve sizes or designations will be in accordance with AASHTO M-92 and STAM C-33.

Throughout these specifications, the term "coarse aggregate" shall mean materials retained on a No. 4 sieve and the term "fine aggregate" shall mean materials passing a No. 4 sieve.

### **SECTION 607A.02 - AGGREGATE FOR PLANT MIX BITUMINOUS BASE**

- A. General - Aggregate shall be composed of coarse and fine aggregates combined in the proper proportions to meet the grading requirements for Grading W of Section 607A.04, Aggregate For Untreated Sub-Base and Base, unless otherwise shown on the plans. Aggregates shall be composed of clean, tough, durable fragments free from an excess of flat, elongated, soft or disintegrated pieces and free from fragments coated with dirt or other objectionable matter.
- B. Coarse Aggregate - Coarse aggregate shall be crushed stone, crushed gravel or natural gravel. Unless otherwise shown on the plans, the material shall have a percentage of wear of not more than fifty when tested in accordance with AASHTO T-96. The sodium sulfate soundness loss shall not exceed 12 percent (12%) in accordance with AASHTO T-104.
- C. Fine Aggregate - Fine aggregate shall consist of crushed stone, crushed gravel, or natural sand. The fraction passing the No. 200 sieve shall not be greater than two thirds (2/3) of the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than three (3), except that when the plasticity index is non-plastic (NP), the liquid limit shall be not more than 30.

### **SECTION 607A.03 - AGGREGATE FOR ROAD MIX BITUMINOUS BASE**

Aggregates for road mix bituminous base shall meet the requirements of Section 607A.04, Aggregate for Untreated Sub-base and Base, for crushed base. Unless otherwise called for on the plans, the combined aggregate and natural filler, where required, shall meet the gradation requirements for grading W. Unless otherwise specified the aggregate used for alley surfacing

shall be grading H.

**SECTION 607A.04 - AGGREGATE FOR UNTREATED SUB-BASE AND BASE**

- A. General - Before production of any of the following materials, all vegetation and stripping material shall be removed from the pit. Only designated portions of the pit will be used. The composite materials shall be free from clay balls, vegetable matter and other deleterious substances and shall not contain an excess of thin or elongated pieces.
- B. Crushed Sub-Base and Crushed Base shall be crushed stone or crushed gravel and an approved soil binder or natural filler, where required, conforming to the following requirements, unless otherwise designated on the plans or in the special provisions.
  - 1. Coarse aggregate shall consist of hard, durable particles or fragments of stone or gravel. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used. Unless otherwise specified, the coarse aggregate shall have a percentage of wear of not more than 50.
  - 2. Fine aggregate shall consist of crushed stone, crushed gravel or natural sand. The fraction passing the No. 200 sieve shall not be greater than two-thirds (2/3) of the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than six (6) except that, when the plasticity index is non-plastic, the liquid limit shall not be more than 30.
  - 3. Crushed base and crushed sub-base shall meet the following gradation requirements for the grading shown on the plans:

Sieve Designation	PERCENTAGE PASSING					
	Grading <u>D</u>	Grading <u>G</u>	Grading <u>H</u>	Grading <u>J</u>	Grading <u>K</u>	Grading <u>W</u>
2"	100	100	-	100	-	-
1 1/2"	95-100	95-100	-	95-100	100	100
1"	-	-	100	-	95-100	95-100
3/4"	-	-	95-100	-	-	-
#4	50-85	-	45-65	35-75	40-65	45-65
#8	40-70	-	33-53	-	30-55	33-53
#200	2-15	0-15	3-12	0-15	3-15	3-12

- C. Sub-base shall be crushed or natural stone or gravel meeting the wear, liquid limit, plasticity index and gradation requirements specified for crushed sub-base.
- D. Crushed run sub-base and crushed run base shall be crusher run material of the maximum size as called for on the plans.

- E. Pit run or screened sub-base and base shall be pit run or screened material of the maximum size called for on the plans.

**SECTION 607A.05 - AGGREGATE FOR FLEXIBLE PAVEMENT - GENERAL:**

- A. General - Aggregates shall be of uniform quality, crushed to size as necessary and shall be composed of sound, tough, durable pebbles or fragments with or without natural or mineral fillers, as required. The aggregate shall be free from vegetable matter, lumps or balls of clay adherent films of clay or other matter that would prevent thorough coating with bituminous material and shall be free of an excess of flat or elongated pieces. The crushed aggregate shall have a percentage of wear of not more than 40, show a sodium sulphate loss of not more than 12 percent and the plasticity index shall not exceed three (3), unless otherwise provided on the plans or approved by the engineer.
- B. Coarse Aggregate - Coarse aggregate shall be crushed stone or crushed gravel of such gradation that when combined with other required aggregate fractions and fillers in proper proportion, the resultant mixture shall meet the gradation required under the composition of mixture for the specific type under contract. Only one kind shall be used on the project except by permission of the engineer.
- C. Fine Aggregate - Fine aggregate shall consist of crushed stone, crushed gravel or natural sand. Fine aggregate shall be of such gradation that when combined with other required aggregate fractions in proper proportion, the resultant mixture shall meet the gradation required under the composition of mixture of the specific type under contract.
- D. Sampling - Sampling and testing of aggregates for flexible pavements shall be in accordance with the following standard methods of the American Association of State Highway Transportation Officials:

Sampling	T-2
Percentage of Wear	T-96
Soundness	T-104
Sieve Analysis	T-27, Wyoming Modified

**SECTION 607A.06 – AGGREGATE FOR HOT PLANT MIX BITUMINOUS PAVEMENT**

When general paving conditions exist and type O pavement is specified, aggregate shall be composed of coarse and fine aggregates combined as shown and in conformance with Section 607A.02, Aggregate for Plant Mix Bituminous Base, of these specifications.

When Type I pavement is specified, the aggregate material prior to crushing shall be of

such a size that not less than 95 percent (95%) shall be retained on a sieve with square openings ¼ inch (¼") larger than the maximum size mineral aggregate being produced, unless otherwise shown on the plans.

When Type II pavement is specified, not less than 50 percent (50%) of the materials by weight retained on the No. 4 sieve shall have at least one fractured face, unless a different percentage of fractured faces is shown on the plans.

The several aggregate fractions for the mixture shall be sized, graded and combined in such proportions that the resulting composite blend meets one of the grading requirements in the following table as specified.

**TABLE-GRADATION REQUIREMENTS**

PERCENTAGE OF WEIGHT PASSING		
SIEVE DESIGNATION	3/4" MAX	1/2" MAX
1"	100	-
3/4"	97 - 100	100
1/2"	-	97 - 100
3/8"	60 - 85	-
#4	40 - 65	45 - 70
#8	25 - 55	25 - 55
#30	10 - 35	15 - 40
#200	2 - 10	2 - 11

**SECTION 607A.07 - AGGREGATE FOR PLANT MIX WEARING COURSE**

The aggregate for plant mix wearing course shall be crushed stone or gravel composed of hard, durable pebbles or fragments and a filler of finely crushed stone, gravel or sand, where required, to provide a composition of aggregates meeting the following requirements for the type specified:

SIEVE DESIGNATION	PERCENTAGE PASSING	
	TYPE A	TYPE B
1/2"	100	100

3/8"	97 - 100	97 - 100
#4	25 - 45	20 - 40
#8	10 - 25	10 - 20
#200	2 - 7	2 - 7

The aggregate shall be free from vegetable matter, lumps or balls of clay, adherent films of clay, or other matter that would prevent thorough coating with bituminous material. Unless otherwise shown on the plans, at least 75 percent (75%) of the material by weight retained on the No. 4 sieve shall be particles having at least one fractured face and shall have a percentage of wear of not more than 35.

When either Type A or Type B wearing course is specified, the aggregate material, prior to crushing, shall be such size that not less than 95% shall be retained on a sieve with square openings of 3/8 inch (3/8").

**SECTION 607A.08 - AGGREGATE FOR ROAD MIX BITUMINOUS PAVEMENT**

Aggregates shall be composed of clean, tough, durable fragments of crushed stone or crushed or natural gravel free from an excess of flat, elongated, soft or disintegrated pieces. The aggregate shall be free from vegetable matter, lumps or balls of clay, adherent films of clay or other matter that would prevent thorough coating with bituminous material.

Unless otherwise specified, the coarse aggregate shall have a percentage of wear of not more than 50. The sodium sulfate soundness loss shall not exceed 12 percent (12%) and plasticity index shall not exceed three (3). The combined coarse and fine aggregate shall meet the following gradation requirements.

<u>Sieve Designation</u>	<u>Percentage Passing</u>
1"	100
3/4"	95 - 100
#4	45 - 65
#8	33 - 53
#200	3 - 12

**SECTION 607A.09 - COVER COAT AGGREGATE FOR BITUMINOUS SURFACE TREATMENT**

This material shall consist of clean, tough, durable fragments free from an excess of flat, soft of disintegrated pieces and free from stone coated with dirt or other objectionable matter. The

aggregate shall have a percentage of wear of not more than 40 or have a plasticity index in excess of three (3). The aggregate material shall be well graded from coarse to fine within the following limits:

<u>Sieve Designation</u>	<u>Type I Percentage Passing</u>
3/4"	100
1/2"	95 - 100
#4	50 - 70
#8	33 - 63
#200	3 - 10

**SECTION 607A.10 - COVER COAT AGGREGATE**

Only one type of aggregate shall be used on the project unless alternate types are approved.

Cover aggregate for seal coats shall be crushed stone, crushed ledge rock, crushed or natural gravel or sand.

Material used for the production of Type A, B or C cover aggregate shall be stone, ledge rock or boulders of such size that prior to crushing not more than five percent (5%) will pass a 3/4" screen for Type A or a 1/2" screen for Type B and Type C.

Type D cover aggregate shall be crushed stone, crushed gravel or clean pea gravel.

Type A, B, C or D shall have a percentage of wear of not more than 35, unless a different percentage of wear is shown on the plans.

Type E cover aggregate shall be crushed sand-gravel. Type S cover aggregate shall be screened or pit-run sand. The plasticity index of either Type E or Type S shall not exceed three (3).

The material produced shall be well graded from coarse to fine within the following gradation requirements for the specified type:

PERCENTAGE PASSING						
SIEVE DESIGNATION	TYPE A	TYPE B	TYPE C	TYPE D	TYPE E	TYPE S
1"	100	-	-	-	-	-
3/4"	95 - 100	100	-	100	100	-

1/2"	30 - 60	95 - 100	100	95 - 100	95 - 100	100
3/8"	-	-	95 - 100	-	-	95 - 100
#4	0 - 15	0 - 15	0 - 20	0 - 15	35 - 70	85 - 100
#8	0 - 7	0 - 7	0 - 12	0 - 7	-	-
#200	0 - 2	0 - 2	0 - 2	0 - 2	0 - 10	0 - 5

**SECTION 607A.11 - BLOTTER**

Blotter material shall be either sand or screenings, free from vegetable matter, clay or other deleterious matter. The material shall be of such size that 100 percent of the material will pass through 3/8" sieve, the fraction passing the No. 4 sieve shall be from 85 - 100 percent and the fraction passing the No. 200 sieve shall not be greater than 20 percent (20%). The plastic index shall not exceed six (6). See Section 608C.

**SECTION 607A.12 - NATURAL FILLER**

Filler shall consist of clean, hard, durable grains of naturally occurring sand or granular material taken from locations shown on the plans or other approved sources.

**SECTION 607A.13 - BED COURSE MATERIAL**

Bed course material for sidewalks and curbing shall consist of cinders, sand, gravel, crushed stone or other approved material of such gradation that all particles will pass through a sieve having 1/2" square openings.

**SECTION 607A.14 - GRAVEL FOR DRAINS**

Gravel for drains shall be crushed or natural sand and gravel or other approved free-draining materials. The material shall be uniformly graded from coarse to fine within the following gradation requirements for the grading indicated on the plans. When the grading is not indicated on the plans, Grading B shall be used.

SIEVE DESIGNATION	PERCENTAGE PASSING		
	GRADING A	GRADING B	GRADING C
2"	100	-	-
1 1/2"	95 - 100	100	-

1"	-	95 - 100	-
3/4"	35 - 70	-	100
3/8"	10 - 30	-	95 - 100
#4	0 - 5	0 - 10	-
#8	-	-	65 - 95
#16	-	-	5 - 30
#100	-	-	0 - 10

**SECTION 607A.15 - AGGREGATE FOR MAINTENANCE STOCKPILES**

- A. TYPE A AGGREGATE - Type A aggregate shall consist of clean, hard, durable particles of crushed gravel or stone free from soft, thin, elongated or laminated pieces or organic material and shall show a percentage of wear of not more than 50 percent (50%). The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than three (3), except than, when the plasticity index is non-plastic the liquid limit shall not be more than 30. The material placed in the stockpile shall meet the following gradation requirements for the maximum size specified:

SIEVE DESIGNATION	PERCENTAGE PASSING	
	1/2" MAXIMUM	3/8" MAXIMUM
3/4"	100	-
1/2"	95 - 100	100
3/8"	-	95 - 100
#4	45 - 65	50 - 70
#8	37 - 57	33 - 63
#200	3 - 12	3 - 12

- B. TYPE B AGGREGATE - Type B aggregate shall consist of clean, hard, durable particles of crusher-run gravel or stone free from soft, thin, elongated or laminated pieces or organic material. Material shall be obtained from designated portions of the pit. The plasticity index shall not be greater than six (6). The material placed in the stockpile shall meet the following gradation requirements for the maximum size specified: not less than 95 percent (95%) of the material shall pass a sieve of the maximum size designated on the



plans; not more than 75 percent (75%) of the material shall pass a No. 4 sieve; and not more than 15 percent (15%) of the material shall pass a No. 200 sieve.

- C. TYPE C AGGREGATE - Type C aggregate shall consist of crusher-run scoria. Not less than 95 percent (95%) of the material placed in the stock pile shall pass a 1/2" sieve.
- D. TYPE D AGGREGATE - Type D aggregate shall consist of clean, hard, durable particles of screened and free from soft, thin, elongated or laminated pieces or organic material. The plasticity index shall not be greater than six (6). The material placed in the stockpile shall meet the following gradation requirements:

<u>SIEVE DESIGNATION</u>	<u>PERCENTAGE PASSING</u>
1/2"	100
3/8"	95 - 100
#4	85 - 100
#200	3 - 12

#### **SECTION 607A.16 - PREVIOUS BACKFILL MATERIAL**

Previous backfill material shall consist of gravel, crushed gravel, crushed rock, natural sand, manufactured sand or combinations thereof and shall meet the following gradation requirements:

<u>SIEVE DESIGNATION</u>	<u>PERCENTAGE PASSING</u>
2"	100
#4	0 - 50
#40	0 - 30
#100	0 - 10
#200	0 - 4

In addition, the fraction passing the No. 40 sieve shall have a liquid limit not greater than 30 and shall be non-plastic (NP).

#### **SECTION 607A.17 - AGGREGATE FOR RIPRAP**

Aggregate for riprap shall be hard, durable, crushed, quarried or natural stone or broken concrete having an apparent specific gravity of not less than 2.4. The absorption shall not exceed four percent (4%), unless otherwise approved by the engineer. The stone shall be free of weak laminations and cleavages and shall be of a quality that will not disintegrate on exposure to water or weathering. The aggregate for the various types of riprap shall meet the following additional requirements:

- A. Class I riprap stone shall consist of two sizes of stone.
  - 1. Primary stone shall be not less than three inches (3") thick and shall weigh not less

than 50 pounds. At least 60 percent of the stone shall weigh more than 80 pounds.

2. Choked stone shall be fragments or spalls of the proper size to satisfactorily wedge between the primary stones as placed.
- B. Class 2 riprap stone shall be graded with a sufficient amount of smaller stones uniformly distributed throughout. A least 60 percent (60%) of the stones shall weigh more than 80 pounds each.
- C. Grouted riprap stone shall conform to the requirements for stone for Class 1 or Class 2 riprap. Grout shall consist of one (1) part Portland cement and three (3) parts sand thoroughly mixed with water to produce a workable mix.
- D. Wire-enclosed riprap aggregate shall be round or angular stones. Not less than 95 percent (95%) of the stone shall be retained on a screen or wire having two-inch (2") square openings.
- E. Sacked concrete riprap aggregate shall consist of pit-run material of a sandy or gravelly nature. The material shall be clean and free from roots, vegetable matter or other deleterious substances. The aggregate shall meet the following gradation requirements.

Passing a 2" Sieve	80 to 100 percent
Passing a No. 200 Sieve	0 to 4 percent

Concrete for sacked concrete riprap shall consist of a mixture of not less than four (4) sacks (376 pounds) of Portland cement per cubic yard and sufficient water to obtain a slump of three to five inches.

**SECTION 607A.18 - FILTER AGGREGATE FOR RIPRAP**

Filter aggregate for riprap shall be hard, durable particles or fragments of crushed stone or natural gravel, screened or crushed to meet the following gradation requirements:

<u>Sieve Designation</u>	<u>Percentage Passing</u>
3"	100
#4	20 - 50
#200	0 - 10

**SECTION 607A.19 - STOCKPILED AGGREGATE**

- A. Description - This work shall consist of storing aggregate material which will be used in construction projects in accordance with these specifications at locations shown on the plans or designated by the engineer.

- B. Materials - The aggregate shall meet applicable parts of Section 607A, Aggregates, for the type of material required.
- C. Construction - Sites for aggregate stockpiles shall be grubbed and cleaned prior to storing aggregates and the site shall be firm and smooth and well drained. Abid of aggregate suitable to avoid the inclusion of soil or foreign material shall be maintained.

The stockpiles shall be built in layers not exceeding four feet (4') in height and each layer shall be completely in place before the next layer is started so as to prevent segregation. The material shall be deposited in such manner as to prevent coning, except in the case of fine aggregate composed of material approximately 90 percent (90%) finer than a No. 4 sieve.

Dumping, casting or pushing over sides of stockpiles will be prohibited except in the case of fine aggregate materials.

Stockpiles of different types or sizes of aggregates shall be spaced far enough apart or separated by suitable walls or partitions to prevent the mixing of the aggregates.

Any stockpiling of materials derived by Wet Pit or Dredging operations other than those stockpiles previously mentioned are subject to prior approval of the engineer and must be submitted in the contractor's plan of operation as specified.

When it is necessary to operate trucks or other equipment on the stockpile in the process of building that stockpile, it should be done in a manner approved by the engineer. Any method of stockpiling aggregate which allows the stockpile to become contaminated with foreign matter or causes excessive degradation of the aggregate will not be permitted. Excessive degradation will be determined by sieve test of samples taken from any portion of the stockpile over which equipment has operated and failure of such samples to meet all grading requirements for the aggregate shall be considered cause for discontinuance of such stockpiling procedures.

The aggregate shall be transferred from the stockpiles in such a way as to obtain a material having a uniform grading.

## **SECTION 607A.20 - EQUIPMENT AND CONSTRUCTION METHODS**

The equipment and methods utilized in the production, transportation and final placement of aggregate materials shall be such as to provide in place materials meeting all requirements as specified.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 607B  
ROAD MIX BITUMINOUS PAVEMENTS**

**SECTION 607B  
ROAD MIX BITUMINOUS PAVEMENTS**

**607B.01 - DESCRIPTION**

These specifications include general requirements that are applicable to all types of road mix bituminous pavements irrespective of the gradation of aggregate, kind and the amount of bituminous material or pavement used.

This work shall consist of constructing one or more courses of a road mix bituminous mixture on the prepared foundation in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections on the plans or established by the engineer.

**607B.02 - BITUMINOUS MATERIALS**

The type and grade of bituminous material will be specified in the contract plans. The grade may be changed one step by the engineer during construction at no change in unit price.

The bituminous material shall meet the applicable requirements of Section 608A, Bituminous Materials.

**607B.03 - AGGREGATES**

The aggregates shall meet the requirements of Section 607A, Aggregates.

The aggregate will be accepted immediately preceding addition of bituminous material to the mix. This acceptance will be based on periodic samples of the windrow after all aggregates have been blended for each lift.

Stockpiled material shall meet the requirements of Section 607A.19, Stockpiled Aggregates.

**607B.04 - WEATHER LIMITATIONS**

The construction of road mix bituminous pavement shall be carried on only when the surface on which the material is to be placed is dry and when the atmospheric temperature is above 50 degrees F and has not been below 40 degrees F during the preceding 24 hours.

**607B.05 - EQUIPMENT**

The equipment used by the Contractor shall include scarifying, mixing, spreading, finishing and compacting equipment, a bituminous distributor and equipment for heating bituminous material. The distributor shall be so designed, equipped, maintained and operated that bituminous material at even heat may be applied uniformly on variable widths of surface up to 15 feet at

readily determined and controlled rates, from 0.05 to 2.0 gallons per square yard, with uniform pressure and with an allowable variation from any specified rate not to exceed 0.02-gallon per square yard. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank and thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

Travelling or stationary mixing plants or other equipment of proven performance may be used by the contractor in lieu of the specified equipment if approved.

Rollers shall be of self-propelled steel wheel tandem or 3-wheel rollers weighing not less than eight-tons each. Pneumatic-tired rollers shall have a total compact width of not less than 60 inches and a gross weight adjustable within the range of 200 to 350 pounds per inch of compaction width. The operating weight shall be as directed. Tire pressure or contract pressure may be specified for pneumatic-tired rollers.

#### **607B.06 - PREPARATION OF BASE**

Before materials for road mixing are spread, the surface on which the road mix is to be placed shall be conditioned as specified in Section 609.12, Conditioning of Existing Surface and primed and tacked, where required, in accordance with Sections 608C, Prime Coat and 608B, Tack Coat, respectively.

#### **607B.07 - PLACING AGGREGATES**

Aggregates shall be uniformly spread on the road by the use of spreader boxes or other approved mechanical spreading devices. When two or more sizes of aggregates are used, each size of aggregate shall be placed in the proper amount to provide for surfacing of the required width and thickness. Each size of aggregate shall be windrowed to uniform section and left undisturbed until measuring and sampling are completed, after which they shall be mixed until they are uniformly blended and then spread over the road surface.

If the surface moisture of the aggregate is more than two percent of the dry weight of the aggregate, except when the bituminous material is emulsified asphalt, the aggregate shall be turned by blades or disc harrows or otherwise aerated until the moisture content is reduced to two percent or less.

The aggregate shall then be spread smoothly and uniformly over half the road or other convenient width of the surface ready for the application of bituminous material, except that when a traveling mixing plant is used, the aggregate shall be formed into a uniform cross-section.

In lieu of aerating and drying the aggregate, the contractor may use an approved additive. The additive shall permit suitable coating of the wet aggregate and shall prevent the bituminous

coating from stripping in the presence of water.

#### **607B.08 - APPLICATION OF BITUMINOUS MATERIAL**

The bituminous material shall be uniformly distributed in successive applications, in such amounts and at such intervals as directed. The mixing equipment shall follow immediately behind the distributor after each application of bituminous material to partially mix the aggregate and the bituminous material. Application temperatures shall be in accordance with Section 608B.06, Application Temperatures.

#### **607B.09 - MIXING**

After the last application of bituminous material and partial mixing, the entire mass of bituminous material and aggregate shall be windrowed on the road surface and then mixed, by blading the mixture from side to side of the road or by manipulations producing equivalent results, until all aggregate particles are coated with bituminous material and the whole mass has a uniform color and the mixture is free from rich or lean spots, balls or uncoated particles. During the mixing operations, care shall be taken to avoid cutting into the underlying course or contaminating the mixture with the earth or other extraneous matter. The mixing process shall be confined to part of the width or area of the road when required to allow traffic to pass.

Should the mixture show an excess, deficiency or uneven distribution of bituminous material, the condition shall be corrected by the addition of aggregate or bituminous material as required and remixing. If the mixture contains excessive amounts of moisture or volatile matter, it shall be bladed, aerated or otherwise manipulated until the moisture and volatile contents are satisfactory. The spreading of the mix shall not be done when the surface to be covered is in an unsatisfactory condition.

At the end of the day's work or when the work is interrupted by weather conditions or otherwise, all loose material shall be bladed into a windrow whether or not mixing is completed and shall be retained in a windrow until operations are resumed.

When the mixing operations have been satisfactorily completed, the mixture shall be formed into a windrow of uniform cross-section.

If the contractor requests and is authorized to use, travelling or stationary mixing plants in lieu of the specified equipment, the same requirements regarding residual moisture and evaporation of volatiles given above shall apply.

#### **SECTION 607B.10 - SPREADING, COMPACTING AND FINISHING**

The material shall be spread by a self-propelled, pneumatic-tired blade grader or mechanical spreader of approved type. Care shall be taken to avoid cutting into the underlying base when the material is spread from the windrow.

After the material is spread, the surface shall be rolled. Rolling shall be parallel to the road centerline and shall commence at the outer edges of the road, overlapping the shoulders and progress toward the center, overlapping on successive passes by at least one-half the width of the roller, except that on super-elevated curves rolling shall progress from the lower to the upper edge. Each pass shall terminate at least three feet (3') in advance or to the rear of the end of the preceding pass. Curing the compaction, the surface shall be dragged or bladed as necessary to fill ruts and to remove incipient corrugations or other irregularities. Rolling shall continue until the surfacing is of uniform texture and satisfactory compaction has been obtained. Initial rolling shall be performed with a pneumatic-tired roller, and final rolling shall be performed with a three-wheel or tandem-type steel wheel roller. Rolling shall be discontinued whenever it begins to produce excessive pulverizing of the aggregate or displacement of the mixture.

Where the compacted thickness of the road mix surface is to be more than two inches (2"), the mixture shall be spread from the windrow and compacted in two layers, the first layer to be bladed and rolled before the second layer is spread.

While the surface is being compacted and finished, the contractor shall trim the edges neatly to line.

#### **SECTION 607B.11 - SURFACE REQUIREMENTS**

The surface will be tested by the engineer using a ten-foot straightedge at selected locations. The variation of the surface shall at no point exceed ¼ inch. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as specified.



**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 607C  
AGGREGATE SUB-BASE AND COURSES**

**SECTION 607C  
AGGREGATE SUB-BASE AND COURSES**

**607C.01 - DESCRIPTION**

This work shall consist of furnishing and placing one or more courses of aggregate and additives, if required, on a prepared surface in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses and typical cross-section shown on the plans or established by the engineer.

**607C.02 - MATERIALS**

The aggregates shall meet the requirements of Section 607A, Aggregates.

Stockpiled materials shall meet the requirements of Subsection 607A.19, Stockpiled Aggregate.

When the stationary plant method is used, the aggregate will be accepted immediately before mixing and prior to the addition of water based on periodic samples taken from the pugmill input.

When a road mix method is used, the aggregate will be accepted after necessary blending and before laying, based on samples taken from the combined windrow for each lift.

**607C.03 - COMMERCIAL ADDITIVES**

The additives, when required, shall meet the following requirements:

HYDRATED LIME -	Hydrated lime shall conform to the requirements of ASTM C-415.
PORTLAND CEMENT -	Portland Cement shall conform to the requirements of AASHTO M 85. Unless otherwise designated or permitted, the following types of Portland Cement shall be used:
Structural Concrete	Type II (low alkali)
Pavement Concrete	Type II (low alkali)
Commercial Additives	Type I or II
Base or Sub-Base Treatment	Type I or II

Masonry Cement shall conform to the requirements of AASHTO M-150.

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.

The contractor shall provide suitable means for storing and protecting the cement against dampness. Cement which, for any reason, has become partially set or which contains lumps of caked cement shall be rejected. Cement salvaged from discarded or used bags shall not be used.

When corrosion resistant concrete pipe is called for on the plans, the following shall apply:

Whenever Type V or Type II Modified Portland Cement is allowed or specified on the plans, the cement shall be either modified Type II low alkali, or Type V low alkali, in accordance with AASHTO M 85 and shall meet the setting time limitations specified therein, except that the modified Type II, low alkali cement, if used, shall have a tricalcium aluminate ( $3 \text{ CaO} \cdot \text{Al}_2\text{O}_3$ ) content of not more than 5.0 percent."

Other additives, when specified, shall meet the requirement set forth on the plans or in the special provisions.

#### **607C.04 - PLACING**

If the required compacted depth of sub-base course exceeds six inches (150 mm), the course shall be constructed in two or more layers of approximately equal thicknesses. The maximum compacted thickness of any one layer shall not exceed six inches (6"). When vibrating or other approved types of special compacting equipment are used, the depth of a single layer of the course may be increased upon approval by the engineer.

#### **607C.05 - MIXING**

The contractor shall mix the aggregate, water and commercial additive where required, by the stationary plant methods unless otherwise shown on the plan or approved by the engineer. The moisture content of the material at the time of compaction shall be within plus 2 or minus 4 percentage points of optimum.

- A. Stationary Plant Method - The aggregate and water shall be mixed in an approved pugmill mixer. Water shall be added during the mixing operation in the amount necessary to maintain the required moisture content for compacting.

The mixer shall be capable of uniformly distributing the aggregate, additives and water throughout the mixture without evidence of over-wet or dry pockets of material when the equipment is operated at the contractor's desired capacity.

After mixing, the material shall be transported to the job site while it contains the proper moisture content and shall be placed on the roadbed by means of an approved aggregate spreader.

The spreader shall be capable of spreading the material for a minimum width of ten feet

(10') when used to full capacity to a uniform thickness.

- B. Travel Plant Method - After the material for each layer has been placed through an aggregate spreader, windrow sizing device or aggregate hopper, the material shall be uniformly mixed by a travelling mixing plant. During mixing, water shall be added in an amount sufficient to maintain the required moisture content for compacting.
- C. Road Mix Method - After material for each layer of the course has been placed, the materials shall be mixed while in the range of plus two or minus four percentage points of optimum moisture content, by means of motor graders or other approved equipment until the mixture is uniform throughout.
- D. Stockpile Method - Commercial additives, if required, will be introduced into the aggregate during stockpiling operations. Water will be introduced by prewetting the stockpile of aggregate and additive. Additional water may have to be introduced during the placing of the aggregate courses.

#### **SECTION 607C.06 - SHAPING AND COMPACTION**

Each layer shall be compacted to a density of not less than 95 percent (95%) of maximum density as determined in accordance with AASHTO T 180, unless otherwise called for on the plans. Compactions of field-in-place densities will be determined by AASHTO T 191 (Wyoming Modified), or by other approved methods. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture and surface is produced and the aggregates firmly keyed. Water shall be uniformly applied over the materials during compaction in the amount necessary for proper consolidation.

#### **SECTION 607C.07 PROOF ROLLING**

Proof roll equipment shall be a dump truck or similar unit with tandem rear axles, with a loaded weight of not more than 55000 pounds or less than 45000 pounds. The truck or unit shall travel back and forth over the area (sub base) at a speed acceptable to the superintendent of streets or the public works director. The equipment shall roll the entire length of the new road base and each succeeding pass shall be offset by not greater than one tire or dual width. The proof roll shall continue until the entire area has been rolled. A depression of one inch or more shall constitute that area as being unacceptable. The depressed area shall be measured by city personnel placing a four-foot straight edge perpendicular to the curb and measuring the depression from the bottom of the straight edge to the depth of the depressed area. The Superintendent of Streets or the Public Works Director shall be present and observe the test prior to completing the paving.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 607D  
RIPRAP**

## **SECTION 607D RIPRAP**

### **SECTION 607D.01 - DESCRIPTION**

This work shall consist of the bank or water course protection courses in accordance with these specifications and in reasonably close conformity with the lines, grades and thicknesses shown on the plans or established by the engineer.

Types of riprap are designated as follows:

Class 1 Riprap - Hand-placed stones on earth or gravel bedding.

Class 2 Riprap - Machine-placed stones on earth or gravel bedding.

Wire Enclosed Riprap - Stones placed in wire fabric enclosures.

Grouted Riprap - Class 1 or 2 Riprap as described above with voids filled with sand-cement grout.

Sacked Concrete Riprap - Hand-placed sacked concrete.

### **SECTION 607D.02 - MATERIALS**

Materials shall meet the requirements specified in the following subsections:

Aggregate for Riprap - 607A.17

Filter Aggregate for Riprap - 607A.18

Wire for wire enclosed riprap shall meet the following requirements:

- A. Woven wire shall be two inches by four inches (2"x4") V-mesh fabric having 12 ½" gauge horizontal wires of two-strand, twisted construction and 12 ½" gauge cross wires. All wire shall meet the requirements of ASTM A116 "Zinc-coated (galvanized) Iron or Steel Farm-Field and Railroad Right-Of-Way Fencing", and shall be Class I or better.
- B. Lacing and tie wire shall be galvanized, 12 ½" gauge smooth steel wire. In lieu of lacing, 9 gauge galvanized hog rings at four inch (4") spacing may be used for fastening ends, sides and stop panels.
- C. Steel stakes may be crane rail, three inch (3") nominal standard pipe, or four inch by 4 inch by 3/8 inch (4"x4"x3/8") angles. Stakes shall not be less than five feet in length. Used rail, pipe or angles may be used, provided that the material is not rusted or damaged to an extent that would affect the strength of the stake.

Sampling of materials shall be in accordance with standard material sampling practices.

Grout shall consist of one part Portland cement and three parts of sand, thoroughly mixed with

water to produce a workable mix.

Sacks for sacked concrete riprap shall be made of at least ten-ounce burlap. Sacks shall be approximately 19 ½" x 36" measured inside the seams when the sack is laid flat, with an approximate capacity of 1.25 cubic feet. Sound, reclaimed sacks may be used.

### **SECTION 607D.03 - ACCEPTANCE**

Wire products used on the project which do not meet the specification requirements for the type of wire specified may, at the direction of the engineer:

- A. be rejected and the contractor required to remove and replace all the out-of-specification material at his expense;
- B. be accepted and left in-place and the contractor's cost of the wire product deducted; or
- C. be accepted at a reduced unit price.

### **SECTION 607D.04 - PREPARATION OF SLOPES**

Slopes on which the riprap is to be placed shall be shaped to allow the full thickness of the specified riprap and any bedding or filter gravel, where required. The slope shall not be steeper than the natural angle of repose of the slope as shown on the plans or directed. Whenever possible, the excavation shall be undisturbed material or, where this is not possible, the underlying material shall be compacted to at least 90 percent (90%) of maximum at optimum moisture content in accordance with the applicable provisions of Section 601.

### **SECTION 607D.05 - FILTER GRAVEL**

When called for on the plans, a layer of filter gravel shall be placed on the slope immediately prior to placement of the riprap stone. The layer shall be shaped to provide the maximum thickness specified. The surface should generally fit the bottom surface of the riprap.

### **SECTION 607D.06 - CLASS 1 - HAND-PLACED STONES**

Where hand-placing of stones is specified, the larger stone shall be placed first with close joints.

The larger rocks shall be placed in the footing trench.

Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a three point bearing on the underlying rocks. The foundation course is the course placed on the slope in contact with the ground surface. Bearing on smaller rocks which may be used for chinking voids will not be acceptable. Placing of rocks by dumping will not be permitted. Interstices shall be as nearly filled as practicable

with smaller stones and spalls.

#### **SECTION 607D.07 - CLASS II - MACHINE-PLACED STONES**

Machine-placed stones shall be so placed as to provide a minimum of voids and the larger rocks shall be placed in the toe course and on the outside surface of the slope protection. The rock may be placed by dumping and may be spread in layers by bulldozers or other suitable equipment.

At the completion of slope protection work, the footing trench shall be filled with excavated material and compaction will not be required.

#### **SECTION 607D.08 - WIRE ENCLOSED RIPRAP**

Wire enclosed segments shall be hand or machine formed to the dimensions shown on the plan. Enclosure segments shall be placed, laced and filled in a workmanlike manner to provide a uniform, dense, protective coat over the area specified.

#### **SECTION 607D.09 - CLASS II - GROUTED RIPRAP**

Clean stone shall be placed on the slope in accordance with the class specified. After the stone has been placed, it shall be drenched or sprinkled with water until the stone is thoroughly moistened. The mixed grout shall be applied while the stone is still moist. During application, the grout shall be worked on top the interstices to completely fill the voids with grout.

Where the depth specified for grouting is in excess of twelve inches (12"), such as in cuts-off walls, the riprap stone shall be placed in twelve-inch (12") lifts and each lift shall be grouted prior to placement of the next lift. The succeeding lifts shall be constructed and grouted before the grout in the previous lift has set.

Grout shall be placed only when the weather is suitable for such work and shall be protected from freezing for at least four days if frost is imminent. The surface of grouted riprap shall be covered with moist earth or wet burlap for not less than three days after placing to allow the grout to properly cure.



**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 608A  
BITUMINOUS MATERIALS**

**SECTION 608A  
BITUMINOUS MATERIALS**

**SECTION 608A.01 - DESCRIPTION**

These specifications include general requirements applicable to all types of bases or pavements that require the application of bituminous materials by spray or mix. Deviations from these general requirements will be indicated in the specific requirements for each type.

**SECTION 608A.02 - MATERIALS**

Bituminous materials shall meet all applicable requirements. No materials or products other than those designated in this section will be added to bituminous material without the express permission of the engineer.

- A. ASPHALT CEMENTS - The grades shown on the plans shall conform to the specification of AASHTO M-226, Table 1, with the following modifications:

TEST	AC-2.5	AC-5	AC-10	AC-20
Penetration, 25C (77F), 100g.,5 sec. minimum	175	100	60	35

The spot test shall be negative for all grades when tested with naphtha xylene solvent using 15 percent (15%) xylene.

- B. LIQUID CUT-BACK ASPHALTS - Liquid cut-back asphalts shall conform to the requirements of AASHTO M-81, AASHTO M-82, and AASHTO M-141. The spot test shall be negative for all grades when tested with naphtha xylene solvent using 15% xylene. the Saybolt-Furol viscosity alternate will not apply.
- C. EMULSIFIED ASPHALT - Emulsified asphalts shall conform to the following requirements:
- (a) Emulsified Asphalt (anionic) AASHTO M-140
  - (b) Emulsified Asphalt (Cationic) AASHTO M-208

The designation "h" added to any grade of Emulsified Asphalt requires the residue from distillation to have a penetration from 40 to 90.

The following exceptions apply to grade CMS-2 only:

- (a) Visc., Saybolt Furol at 122° F., Second 50 Min-500 Max
- (b) Distillation: Residue 60 Min.
- (c) Distillation: Oil Distillate, by volume of emulsion: to be determined by the laboratory from produced materials, not to exceed 20%.

Bituminous material may be conditionally accepted at the source based on test reports furnished by the contractor for each 40 tons or 10,000 gallons loaded.

The sample of each load of Asphaltic Materials is to be obtained at the time of conveyance loading and the Certificate of Compliance, together with this sample, shall be surrendered to the engineer on the project. Sampling shall be accomplished using methods described and outlined in AASHTO T-40.

Tank trucks delivering bituminous material to the project shall be equipped with a sampling cock on the discharge pipe.

Bituminous material used on the project which do not meet the specification requirements for the type and grade specified may, at the direction of the engineer:

- (1) Be rejected and the contractor required to remove and replace all material affected by the out-of-specification material at his expense;
- (2) Be accepted and left in-place and the contract price of the bituminous material deducted or be accepted at a reduced unit price as directed by the engineer.

#### **SECTION 608A.04 - ANTI-STRIPPING AGENTS**

When designated on the plans or in the contract by the letter "F" following the bituminous material type designation, a satisfactory anti-stripping agent shall be added to the material at the refinery.

The presence of anti-stripping agents will be determined in accordance with the Wyoming Quick Bottle Test or other approved means.

#### **SECTION 608A.05 - EMULSIFIED ASPHALTS**

The rate of emulsified asphalt used for fog seal or tack shown in the materials and rates summary in the plans is the rate of emulsified asphalt as received from the refinery.

The emulsified asphalt used for tack may be diluted in the field at a rate of 50% emulsified asphalt and 50% additional water.

The emulsified asphalt used for fog seal may be diluted in the field at a rate of 33% emulsified asphalt and 67 percent (67%) additional water.

The water used for the dilution shall be free of sediment and other deleterious matter.

The dilution water and emulsion shall both be heated to approximately 100° F. prior to mixing and this approximate temperature shall be maintained during the application. Dilution shall be made by introducing the water into the emulsified asphalt.

**SECTION 608A.06 - APPLICATION TEMPERATURES**

Bituminous materials for the various types of application shall be loaded and applied within the temperatures indicated in the following table:

TYPE & GRADE OF MATERIAL	APPLICATION - SPRAY DEGREES FAHRENHEIT	MIXING TEMPERATURE DEGREES FAHRENHEIT
RT 1, 2 & 3	60 - 130	60 - 130
RT 5 & 6	85 - 150	85 - 150
RT 7, 8 & 9	150 - 225	150 - 225
RT 10, 11 & 12	175 - 250	175 - 250
RC 70	100 - 180	90 - 140
250	160 - 220	140 - 175
800	175 - 250	170 - 210
3000	220 - 275	200 - 240
MC 30	90 - 180	60 - 120
70	120 - 200	95 - 140
250	160 - 220	140 - 200
800	175 - 250	175 - 240
3000	200 - 290	200 - 250
SC 70	120 - 200	95 - 140
250	160 - 220	140 - 200

800	175 - 250	175 - 210
3000	200 - 290	200 - 250
ALL EMULSIONS	50 - 140	50 - 140
ALL PENETRATION GRADES ASPHALT CEMENT	350 MAX	AS REQUIRED TO ACHIEVE VISCOSITY OF 75 - 150 SECONDS SAYBOLT FUROL

The maximum loading temperatures for asphalt cement shall be 350° Fahrenheit.

**CITY OF LANDER, WYOMING  
STANDARDS & SPECIFICATIONS  
SECTION 608B  
TACK COAT**

## **SECTION 608B TACK COAT**

### **SECTION 608B.01 - DESCRIPTION**

This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the engineer.

### **SECTION 608B.02 - BITUMINOUS MATERIAL**

The type of bituminous material will be specified in the contract, and the grade will be designated by the engineer.

The bituminous material shall meet the applicable requirements of Section 608A, Bituminous Materials.

### **SECTION 608B.03 - EQUIPMENT**

The contractor shall provide equipment for heating and applying the bituminous material.

### **SECTION 608B.04 - PREPARATION OF SURFACE TO BE TREATED**

The existing surface shall be patched and cleaned and shall be free of irregularities to provide a reasonably smooth and uniform surface to receive the treatment. Unstable corrugated areas shall be removed and replaced with suitable patching materials. The edges of existing pavements and concrete which are to be adjacent to new pavement shall be cleaned to permit the adhesion of bituminous materials.

### **SECTION 608B.05 - APPLICATION OF BITUMINOUS MATERIAL**

The bituminous material shall be uniformly applied with a pressure distributor.

The tack coat shall be applied in such manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.

The tack coat shall not be applied during wet or cold weather, after sunset or to a wet surface. The quantity, rate of application and areas to be treated shall be approved prior to application. Application temperatures shall be in accordance with Section 608A.06 - Application Temperatures.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 608C  
PRIME COAT**



## **SECTION 608C PRIME COAT**

### **SECTION 608C.01 - DESCRIPTION**

This work shall consist of preparing and treating an existing surface with bituminous material and blotter material, if required, in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the engineer.

### **SECTION 608C.02 - BITUMINOUS MATERIALS**

The type of bituminous material will be specified in the contract and the grade will be designated by the engineer. The bituminous material shall meet the applicable requirements of Section 608A, Bituminous Material.

### **SECTION 608C.03 - BLOTTER MATERIAL**

Blotter material shall meet the requirements of Section 6078.11, Blotter. The material will be accepted based on periodic samples taken at the latest practicable point prior to incorporation into the work.

### **SECTION 608C.04 - WEATHER LIMITATIONS**

Prime coat shall be applied only when the surface on which the material is to be applied is dry and when the atmospheric temperature is above 50°F.

### **SECTION 608C.05 - EQUIPMENT**

The contractor shall provide equipment for heating and applying the bituminous material and for applying blotter material.

### **SECTION 608C.06 - PREPARATION OF SURFACE**

The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations segregated material or other irregularities and shall be uniformly compacted. Delays in priming shall require reprocessing or reshaping to provide a smooth, compacted surface.

### **SECTION 608C.07 - APPLICATION OF BITUMINOUS MATERIAL**

Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained through construction, not more than one-half of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junction of

spreads is not in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected. When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface and will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.

The quantities, rate of application and areas to be treated shall be approved before application of the prime coat. Application temperatures shall be in accordance with Section 608A, Bituminous Materials.

#### **SECTION 608C.08 - APPLICATION OF BLOTTER MATERIAL**

If, after the application of the prime coat, the bituminous material fails to penetrate and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 608D  
SEAL COAT**

## **SECTION 608D SEAL COAT**

### **SECTION 608D.01 - DESCRIPTION**

This work shall consist of an application of bituminous material followed by an application of cover coat material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the Engineer.

### **SECTION 608D.02 - BITUMINOUS MATERIAL**

The type of bituminous material will be specified in the contract and the grade will be designated by the engineer. The bituminous material shall meet the applicable requirements of Section 608A, Bituminous Materials.

### **SECTION 608D.03 - COVER COAT MATERIAL**

Cover coat material shall meet the requirements of Section 607A.10, Cover Coat Aggregate, for the type specified. The material will be accepted based on periodic samples taken at the latest practicable point prior to incorporation into the work. Stockpiled material shall meet the requirements of Section 607A.19, Stockpiled Aggregates.

### **SECTION 608D.04 - WEATHER LIMITATIONS**

Seal coat shall be applied only when the surface on which the material is to be applied is dry and when the atmospheric temperature is above 40°F.

### **SECTION 608D.05 - EQUIPMENT**

The following equipment or its equivalent shall be required:

- (a) Equipment for heating and applying bituminous material.
- (b) A rotary power broom.
- (c) One pneumatic-tired roller which shall be self-propelled, and of which the gross load shall be adjustable to apply 200 to 350 pounds per inch of rolling width as directed. Tire pressure or contract pressure may be specified for pneumatic-tired rollers. Pneumatic-tired rollers shall be operated at a maximum speed of five (5) miles per hour.
- (d) One self-propelled aggregate spreader of approved design supported by at least four (4) wheels equipped with pneumatic tires on two (2) axles. The aggregate spreader shall be equipped with a means of applying the larger cover coat material to the surface ahead of the smaller cover coat material and with positive controls so that the required amount of

material will be deposited uniformly over the full width of the bituminous material. Other types of aggregate spreaders may be used provided they accomplish equivalent results and are approved.

#### **SECTION 608D.06 - PREPARATION OF SURFACE**

Seal coating operations shall not be started until the surface is thoroughly compacted. Bituminous material shall not be spread until the surface has been cleaned as required and the section to be sealed has been approved.

#### **SECTION 608D.07 - APPLYING BITUMINOUS MATERIAL**

Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used per square yard shall be as directed. If the texture of the surface is such that bituminous material penetrates too rapidly, a preliminary application of from .05 to 0.10 gallon per square yard of surface may be required. A strip of building paper, at least three feet (3') in width and with a length equal to that of the spray bar of the distributor plus one foot (1') shall be used at the beginning of each spread. If the cut-off is not positive, the use of paper may be required at the end of each spread. The paper shall be removed and disposed of in a satisfactory manner. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface.

The spreads of bituminous material shall not be more than six inches (6") wider than the width covered by the cover coat material from the spreading device. Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, setup, dry or otherwise impair retention of the cover coat.

The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous materials on the surface of the traveled way.

#### **SECTION 608D.08 - APPLICATION OF COVER COAT MATERIAL**

Immediately following the application of the bituminous material, cover coat material shall be spread in quantities as designated. Spreading shall be accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material.

The cover coat material shall be moistened with water when required to eliminate or reduce the dust coating of the aggregate. Moistening shall be done the day before the use of aggregates.

Immediately after the cover coat material is spread, any deficient areas shall be covered by additional material. Pneumatic-tire rolling shall begin immediately and shall be continued until

three (3) complete coverages are obtained. Pneumatic-tire rolling shall be completed the same day the bituminous material and cover coat materials are applied.

After the application of the cover coat material, the surface where specified shall be lightly broomed or otherwise maintained as directed for a period of four (4) days, or as directed. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free bituminous material and cover any area deficient in cover coat material. The maintenance shall be conducted so as not to displace imbedded materials. Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by the engineer.

#### **SECTION 608D.09 - PLAIN SEAL**

When plain seal is specified, the work shall consist of the application of bituminous material and a sand cover coat, where required. Plain seal shall be applied when the surface is dry and the weather conditions are suitable for the proper application of the bituminous material specified. Areas where bituminous materials would be picked up, or the seal otherwise damaged by traffic, shall be covered by a protective coat of sand. When confined to small areas, the sand coat may be applied by hand spreading and smoothed by sweeping.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 608E  
BITUMINOUS SURFACE TREATMENT**

**SECTION 608E  
BITUMINOUS SURFACE TREATMENT**

**SECTION 608E.01 - DESCRIPTION**

This work shall consist of the construction of a single or multiple course bituminous surface treatment in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the engineer. The bituminous surface treatment may consist of the application of one or more seal coats or may consist of a prime coat followed by one or more seal coats as specified.

**SECTION 608E.02 - BITUMINOUS MATERIAL**

The type of bituminous material will be specified in the contract and the grade will be designated by the engineer. The bituminous material shall meet the applicable requirements of Section 608A, Bituminous Materials.

**SECTION 608E.03 - AGGREGATES**

Aggregates and blotter material shall meet the requirements of Section 607A.10, Cover Coat Aggregate, for the sizes specified. The material will be accepted based on periodic samples taken at the latest practicable point prior to incorporation into the work. Stockpiled material shall meet the requirements of Section 607A.19 Stockpiled Aggregates.

**SECTION 608E.04 - PRIME COAT**

The prime coat, when specified, shall be applied in accordance with the requirements of Section 608C, Prime Coat. A curing period of three (3) days may be required between the application of the prime coat and the next application of bituminous material.

During the period between the application of the prime coat and the seal coat, the primed surface shall be kept in repair. All holes, ravels and areas deficient in prime shall be patched and repaired with bituminous treated materials, by penetration methods or other approved procedures.

**SECTION 608E.05 - SEAL COAT**

Each seal coat shall be applied in accordance with Section 608D, Seal Coat. If successive seal coats are to be applied, the first seal coat shall be maintained and permitted to cure for a period of three (3) days.



**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 609  
PLANT MIX PAVEMENTS**

**SECTION 609  
PLANT MIX PAVEMENTS**

**SECTION 609.01 - GENERAL**

All plant mix pavements construction within the City of Lander street system for future acceptance into the City of Lander street system shall be installed in accordance with these specifications.

**SECTION 609.02 - ENGINEERING PLANS**

Plant mix pavements shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City Engineer. Plans shall conform with the City of Lander minimum design standards.

**SECTION 609.03 - LICENSES AND PERMIT REQUIRED**

All construction shall be performed by a licensed and bonded General Contractor. A permit shall be secured by the contractor from the City of Lander at least forty-eight (48) hours before commencing construction. The City engineer shall be notified twenty-four (24) hours before the planned construction is to commence and also before starting up whenever construction is delayed for any reason. The City engineer may deny non-emergency permits during the winter season due to unfavorable working conditions.

**SECTION 609.04 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specifications and standard construction practices are being met. The cost of these tests shall be paid for by the City if it is acceptable. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the contractor's or developer's surety.

**SECTION 609.05 - WARRANTY OF WORK**

The contractor shall warrant all work to be free of defects in workmanship or materials for a period of one year from the date of final acceptance of all work performed. The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City Engineer.

**SECTION 609.06 - DESCRIPTION**

These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type irrespective of gradation of aggregate, kind and amount of

bituminous material or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work shall consist of one or more course of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract and in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the plans or established by the engineer.

#### **SECTION 609.07 - BITUMINOUS MATERIALS**

The type and grade of bituminous material will be specified in the contract. The bituminous material shall meet the applicable requirements of Section 608A, Bituminous Materials.

#### **SECTION 609.08 - AGGREGATES**

Aggregates shall meet the applicable requirements of Section 607A, Aggregates. During crushing operations, the coarse and fine aggregates shall be stockpiled in separate piles in such a manner that they can later be combined to meet the required specifications. Stockpiled material shall meet the requirements of Section 607.09, Stockpiled Aggregates.

#### **SECTION 609.09 - NATURAL FILLER**

Natural filler, when required, shall be stockpiled separately. The plans may limit or prohibit the use of crusher rejects or material from the same source as the aggregate material.

#### **SECTION 609.10 - COMMERCIAL ADDITIVES**

The type of commercial additive to be used will either be designated on the plans or when no specific type is designated, any of the commercial additives conforming to either of the following requirements may be used:

- A. **PORTLAND CEMENT** - Portland cement shall conform to the requirements of AASHTO M-85.

Unless otherwise permitted by the engineer, the product of only one mill of any other brand and type of Portland cement shall be used on the project.

The contractor shall provide suitable means for storing and protecting the cement against dampness. Cement which, for any reason, has become partially set or which contains lumps of caked cement shall be rejected. Cement salvaged from discarded or used bags shall not be used.

- B. **HYDRATED LIME, COMMERCIAL ADDITIVE** - Hydrated lime shall conform to the requirements of ASTM C-415, except that not less than Ninety-three percent

93% of the hydrated lime shall consist of calcium and magnesium oxides.

### **SECTION 609.11 - COMPOSITION OF MIXTURES**

The bituminous plant mix shall be composed of a mixture of aggregate, natural filler or commercial additive, if required, and bituminous material. The several aggregate fraction shall be sized, uniformly graded and combined in such proportions that the resultant composite blend meets the job-mix formula.

The contractor shall submit for the engineer's approval a job-mix formula for each mixture to be supplied for the project. The job-mix formula with the allowable tolerances shall be within the master range specified. The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single mixing temperature. The percentage of bituminous material to be added will be designated by the engineer.

The temperature of the mixture prior to laydown shall not be more than 25° less than the mixing temperature.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances:

Passing No. 4 and Larger Sieves	+7%
Passing No. 8 to No. 100 Sieves	+5%
Passing No. 200 Sieve	+4%
Bituminous Material	+0.5%
Mixing Temperature	+20°F

When unsatisfactory results or other conditions make it necessary, the engineer may establish a new job-mix formula.

Should a change in sources of material be made, a new job-mix formula shall be established before the new material is used.

In general, the point of acceptance for the aggregate will be after the material has passed through the gradation unit and prior to the addition of bituminous material. If this point of acceptance proves unsatisfactory, an alternate point of acceptance may be selected by the engineer. The bituminous material will be conditionally accepted at the source. The plant-mixed material will be accepted after blending and mixing at the plant.

### **SECTION 609.12 - WEATHER LIMITATIONS**

Bituminous plant mix shall not be placed on any wet surface or when the atmospheric temperatures are less than those specified in the following table or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures:

## ATMOSPHERIC TEMPERATURE LIMITATIONS

<u>Compacted Thickness</u>	<u>Surface Course</u>	<u>Sub-Surface Course</u>
	*9/15 - 5/1 *5/1 - 9/15	
Less than one inch	60° F    40°F	55°F
1 inch to and including 2 inches	40°F	35°F
More than 2 inches to and including 4 inches	35°F	35°F
More than 4 inches	DOES NOT APPLY	25°F**

\* Or date as shown on plans

\*\* Only on dry surface, not frozen and when air temperatures are rising.

The meanings of the terms "Surface Course" and "Sub-Surface Course" apply to this subsection only and shall be as follows:

1. Any plant mix pavement overlaid with plant mix wearing course on the same contract is considered a subsurface course.
2. Plan mix bituminous base is considered a subsurface course.
3. Spot leveling or the bottom lift of a leveling course may be placed at 35°F if additional course are placed on the same contract.
4. Plant mix wearing course shall be placed between the dates of June 1 and September 15.

### **SECTION 609.13 - BITUMINOUS MIXING PLANT**

Sufficient storage space shall be provided for each size of aggregate and the different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the drier.

Plants used for preparation of bituminous mixtures shall conform to all requirements under (a) below, except that scale requirements shall only be where weight proportioning is used. In addition, batch mixing plants shall conform to the requirements under (b), and continuous mixing plants shall conform to the requirements under (c).

- (a) Requirements for all plants. Mixing plants shall be of sufficient capacity and

coordinated to adequately handle the proposed bituminous construction.

1. Plant Scales - Scales shall be accurate to 0.5 percent of the maximum load that may be required. Poises shall be designed to be secured in any position to prevent inadvertent change of position. The contractor may provide an approved automatic printer system which will print the weights of the material delivered, provided the system is used in conjunction with an approved automatic batching and mixing control system. Such weights shall be evidenced by a weight ticket for each load.

Scales shall be checked as often as deemed necessary to assure their continued accuracy. The contractor shall have on hand not less than ten (10) 50-pound weights for checking of the scales.

2. Equipment for Preparation of Bituminous Material - Tanks for the storage of bituminous material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank. The circulating system for the bituminous material shall be designed to assure proper and continuous circulation during the operating period. Provision shall be made for measuring and sampling storage tanks.
3. Feeder for Drier - The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained.
4. Drier - The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process. For cold-type bituminous mix, equipment for mechanical cooling of the dried aggregate to the temperature prescribed for cold mixtures shall be provided and shall be capable of supplying prepared material for the mixer to operate at full capacity.
5. Screens - Plant screens, capable of screening all aggregates to the specified sizes and proportion and having normal capacities in excess of the full capacity of the mixer, shall be provided.
6. Bins - The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for commercial additives when used, and the plant shall be equipped to feed such material

into the mixer. Each bin shall be provided with overflow pipes of such size and at such location as to prevent backing up of material into other compartments or bins. Each compartment shall be provided with its individual outlet gate, constructed so that when closed, there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points.

7. Sampling Facilities - The plant shall be equipped with suitable sampling devices or facilities to insure representative samples. If the Engineer is unable to obtain samples which represent the material being accepted for incorporation into the project, the Contractor shall make necessary adjustments or revisions to the plant before any further mixing is done.
8. Bituminous Control Unit - Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix. The accuracy of bituminous content measured either by weighing or metering may be checked by computing the daily yield of total material being processed.
9. Thermometric Equipment - An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with an approved temperature recording device so placed at the discharge chute of the drier as to register automatically or indicate the temperature of the heated aggregates. The printed temperature recordings shall be furnished to the Engineer after each day's run.

10. Dust Collector - The plant shall be equipped with a dust collector constructed to return uniformly to the hot elevator all or any part of the material collected as directed.
11. Truck Scales - The bituminous mixture shall be weighed on approved scales. Such scales shall be inspected as often as the Engineer deems necessary to assure their accuracy.

(b) Requirements for Batching Plants:

1. Weigh Box or Hopper - The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without running

over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.

2. Bituminous Control - The equipment used to measure the bituminous material shall be accurate to plus or minus 0.5 percent. The bituminous material bucket shall be non-tilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than 3/4 the length of the mixer and it shall discharge directly into the mixer. The bituminous material bucket, its discharge valve or valves, and spray bar shall be adequately heated. Stem jackets, if used, shall be efficiently drained, and all connections shall be so constructed that they will not interfere with the efficient operation of the bituminous scales. The capacity of the bituminous material bucket shall be at least 15 percent (15%) in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

The indicator dial shall have a capacity of at least 15 percent (15%) in excess of the quantity of bituminous material used in a batch. The controls shall be constructed so that they may be secured at any dial setting and will automatically reset to that reading after the addition of bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over and all of the bituminous material required for one batch will be discharged in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of bituminous material the full length of the mixer.

3. Mixer - The batch mixer shall be an approved twin pugmill type capable of producing a uniform mixture within the job-mix tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

The clearance of blades from all fixed and moving parts shall not exceed one inch.

4. Control of Mixing Time - The mixer shall be equipped with an accurate time lock to control the operation of a complete mixing cycle. It shall lock the weigh box gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the bituminous material bucket throughout the dry mixing period and shall lock the mixer gate throughout the wet and dry mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh box gate



and the start of introduction of bituminous material. The wet mixing period is the interval of time between the start of introduction of bituminous material and the opening of the mixing gate.

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 up to three (3) minutes.

The setting of time intervals shall be performed in the presence of the Engineer, who shall then lock the case covering the timing device until such time as a change is to be made in the timing periods.

(c) Requirement for Continuous Mixing Plants:

1. Aggregate Proportioning - The plant shall include means for accurately proportioning each size of aggregate.

The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled, individual gate to form an orifice for volumetrically measuring the material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjustable by positive mechanical means and secured against inadvertent movement.

Indicators shall be provided for each gate to show the respective opening in inches.

2. Weight Calibration of Aggregate Feed - The plant shall include a means for calibration of gate openings by weighing test samples. Provision shall be made so that materials fed out of individual orifices may be bypassed to individual test boxes. The plant shall be equipped to conveniently handle individual test samples weighing not less than 200 pounds, and accurate scales shall be provided by the Contractor to weigh such test samples.
3. Synchronization of Aggregate Feed and Bituminous Material Feed - Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of bituminous material from the meter or other proportioning device. This control shall be accomplished by interlocking mechanical means or by any other positive, satisfactory method.
4. Mixing - The plant shall include a continuous mixer of an approved twin pugmill type, adequately heated and capable of producing a uniform mixture within the job-mix tolerances.

It shall be equipped with a discharge hopper 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 mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge. Charts shall be provided showing the rate of feed of aggregate per minute for the aggregate being used.

The clearance of blades from all fixed and moving parts shall not exceed one inch (1").

#### **SECTION 609.14 HAULING EQUIPMENT**

Trucks used for hauling bituminous mixtures shall have tight, clean, smooth, metal beds which have been thinly coated with a minimum amount of paraffin oil or other approved material to prevent the mixture from adhering to the beds. This material shall not be used in amounts which will contaminate the mixture. When required, each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather. When necessary, so that the mixture will be delivered on the road at the specified temperature, truck beds shall be insulated and covers shall be securely fastened.

Railroad cars used for transportation of cold-laid bituminous mixtures shall be in good condition and without pockets. All projecting spikes, nails, foreign material, and other obstructions likely to interfere with efficient unloading shall be removed from the cars. The bottoms of the cars shall be covered with a thin layer of clean sand or screening, and the top of the load shall be protected from contamination by moisture or foreign materials, and from the loss of volatile material.

#### **SECTION 609.15 BITUMINOUS PAVERS**

Bituminous pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thicknesses shown on the plans. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant mix material in widths shown on the plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

Pavers shall be equipped with a paver control system which will automatically control the laying of the mixture to specified transverse slope and established longitudinal grade. The paver control system shall be automatically actuated from an independent line and grade control reference and through a system of mechanical sensors and sensor-directed devices which shall maintain the paver screed at the proper transverse slope and at proper height to establish the top surface of the finally compacted mixture at specified slope and grade. In case of failure of the control system, the paver shall be operated by mechanical control only until the material under production at the time of breakdown is laid.

The paver shall be capable of being operated, when laying mixtures, at forward speeds consistent with satisfactory laying of the mixture.

All rollers shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. The use of equipment which results in excessive crushing of the aggregate will not be permitted.

#### **SECTION 609.17 CONDITIONING OF EXISTING SURFACE**

When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross section as directed.

When specified in the contracts, all longitudinal and transverse joints and all cracks shall be sealed by the application of an approved joint sealing compound before the mixture is spread upon a pavement surface. All excessive bituminous material shall be removed from joints and cracks prior to placement of mixture.

#### **SECTION 609.18 PREPARATION OF BITUMINOUS MATERIAL**

The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times. Charts showing specified temperature range for each source of supply are available from the Headquarters Laboratory of the Wyoming Highway Department.

#### **SECTION 609.19 PREPARATION OF AGGREGATE**

The aggregates for the mixture shall be dried and heated to the required temperature. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate or coating the aggregate with soot, oil, or other contaminates.

The aggregates, immediately after heating and drying, shall be screened into two or more fractions and conveyed into separate compartments ready for batching and mixing with

bituminous material. Screening shall be at such rate and in such manner that the coarse aggregate bin or bins shall contain less than ten percent (10%) of minus No. 4 material and the fine bin shall contain less than ten percent (10%) of plus No. 4 material.

## **SECTION 609.20 MIXING**

The dried aggregate shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gauged and introduced into the mixer in the amount specified by the job-mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, unless otherwise specified, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured.

For hot mix bituminous pavement, the mixture shall be produced at the lowest possible temperature that will produce a workable mix within the application temperatures specified under Section 608A.06, APPLICATION TEMPERATURES. The bituminous material and aggregate shall be introduced into the mixer within the specified temperature range and shall be within 25° F of each other.

## **SECTION 609.21 SPREADING AND FINISHING**

The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

When the total compacted thickness of the mat is to be in excess of two inches (2"), it shall be placed in two or more lifts. The compacted thickness of any one lift in multiple-life construction shall not exceed two inches (2").

Except on tapers, narrow median areas, shoulders, and other such areas of irregular shape, limited length or restrictive width, or such other areas as directed, the paver screed shall be controlled by the automatic screed control described under Section 609.15, BITUMINOUS PAVERS.

The Engineer will perform such engineering as may be required to establish controls for the work and will set references for line and grade controls at reasonable intervals along the work.

The Contractor shall furnish, place, and maintain such materials, devices, and equipment as may be required to provide specified independent line and grade control references and other controls which may be required for proper execution of the work.

Line and grade control for use with automatic paver control systems shall be an independent control reference consisting of:

- (1) A tightly stretched wire of string line offset and paralleling true line for pavement edge and established grade for pavement surface;
- (2) A floating beam of not less than 20 feet (20') in length attached to the paver and riding on previously placed base or pavement material. The beam shall be equipped with a floating string or other device that will actuate the automatic screed control in reference to the base on which it is riding. Unless otherwise permitted by the Engineer, the first ribbon of the first course of pavement material shall be controlled by the independent control wire. Subsequent ribbons may be controlled by the beam reference system.

The longitudinal joint in one layer shall offset that in the layer immediately below, by at least six inches (6").

Defects caused by trucks bumping into the laydown machine or by unnecessary stopping due to a lack of coordination between mixing, hauling, and laydown shall be removed and replaced in accordance with Section 609.24 SURFACE TOLERANCE.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked, and luted by hand tools. For such areas the mixture shall be dumped, spread, and screened to give the required compacted thickness.

Plant mix surfacing ribbons shall be brought up approximately even at the end of each shift on those projects being constructed under traffic.

#### **SECTION 609.22 COMPACTION**

Immediately after the bituminous mixture has been spread and struck off and the surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. Rolling shall be continued while the mixture is in a workable condition until all roller marks are eliminated and, unless otherwise designated on the plans, until a minimum of 95 percent (95%) of the maximum density as established by Marshall test results as determined by an approved laboratory has been obtained. Samples will be taken in accordance with AASHTO T-230, or density will be determined by the use of properly calibrated Nuclear Density Gauge.

The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction without undue displacement, cracking, or shoving. Pneumatic tires shall be inflated to obtain the contact area pressures designated by the Engineer.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each trip overlapping one-half the roller width. Rollers shall move at a slow,

uniform speed with the drive wheels or rolls nearest the paver except on steep grades.

When the pavement is placed by machines in echelon or abutted against a previously placed lane, the longitudinal joint shall be rolled first, followed by the regular rolling procedure. On super-elevated curves, the rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline.

Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture when required. Care should be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture.

To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with very small quantities of detergent or other approved material. Excess liquid will not be permitted.

Along forms, curbs, headers, walls, and other places not accessible to the rollers, the mixture shall be thoroughly compacted with hot hand tampers, smoothing irons, or mechanical tampers. On depressed areas, a trench roller may be used, or cleated compression strips may be used under the roller to transmit compression to the depressed area.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced.

### **SECTION 609.23 JOINTS**

Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the engineer. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. When directed by the engineer, a brush coat of bituminous material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

The surface will be tested by the engineer using a 10-foot straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall at no point exceed 3/16-inch. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material, or as directed.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 701  
CHAIN LINK FENCE**

## **SECTION 701 CHAIN LINK FENCE**

### **SECTION 701.01 - GENERAL**

All chain link fence constructed for the City of Lander shall be installed in accordance with these specifications. The fence height shall be as shown on the plans.

### **SECTION 701.02 - ENGINEERING PLANS**

Chain link fence shall be constructed in accordance with engineering plans prepared under the direction of a professional engineer and approved by the City Engineer. Plans shall conform with the City of Lander minimum design standards.

### **SECTION 701.03 - INSPECTION AND TESTING**

All work shall be inspected by the City's representative, who shall have authority to call for testing of any material or work to assure that these specification and standard construction practices are being met. Any material or work found deficient shall be replaced or corrected before acceptance by the City. If the deficiencies are not corrected, performance shall be required of the Contractor's or Developer's Surety.

### **SECTION 701.04 - WARRANTY OF WORK**

The Contractor shall warrant all work to be free of defects in workmanship or material for a period of one year from the date of final acceptance of all work performed.

The determination of the necessity during the warranty period for the contractor to repair or replace the work in whole or in part shall rest entirely with the City Engineer.

### **SECTION 701.05 - MATERIAL TEST CERTIFICATES**

The contractor must provide test reports for ASTM A90 and ASTM A239 taken on production samples representatives of materials to be furnished for this project, as required by the engineer.

### **SECTION 701.06 - CERTIFICATE OF COMPLIANCE**

The contractor must submit evidence satisfactory to engineer that materials and finishes meet requirements of these specifications.

### **SECTION 701.07 - CHAIN LINK FENCE AND GATES MATERIALS**

- A. General Requirements: All posts, rails, rods, bars, fittings and hardware shall be hot-dipped zinc-coated steel per ASTM Specification A120, A123, and A153, as applicable.



- B. Fabric: Chain link in accordance with ASTM A392, high carbon steel, zinc-coated Class II (2.0 oz. per sq. ft.), passing 10-dip emersion Preece test (ASTM A239), No. 9 gauge x 2 inch mesh, hot-dipped after weaving, twisted and barbed at top and bottom salvages, 72-inch height (fabric roll width) and other sizes as indicated on drawing.
- C. Terminal Posts: All end, corner and pull posts, 2-7/8" O.D. Standard pipe.
- D. Intermediate Posts: 1-7/8 inch O.D. pipe.
- E. Gate Hinge Posts:
  - 1. Single Leaves to 13-foot wide: 2-7/8 inch O.D. pipe.
- F. Top Rails and Post Braces: 1-5/8 inch O.D. pipe.
- G. Gate Frames:
  - 1. Outer Frame: 1-7/8 inch O.D. pipe (all four sides).
  - 2. Cross of "+" Bracing: 1-5/8 inch O.D. pipe.
- H. Truss Rods: 3/8 inch diameter round rod.
- I. Tension Bars (Stretcher Bars): 3/16" x 3/4" flat high carbon steel.
- J. Tension Wire: No. 7 gauge galvanized coiled spring wire.
- K. Fitting and Hardware: All standard fittings required for the complete fence assembly including gates shall be malleable cast iron or pressed steel. All ferrous material shall be hot-dipped galvanized.

#### **SECTION 701.08 - CONCRETE**

Concrete shall be class C with a minimum 28 day compressive strength of 3000 PSI. (City of Lander Standards and Specifications Section 501.)

#### **SECTION 701.09 - INSTALLATION**

- A. General: Install as indicated on plans, shop drawings and in accordance with CLFMI specifications by skilled mechanics experienced in erection of chain link fence and gates.
- B. Set terminal, intermediate and gate hinge posts in concrete footings in the ground to a minimum depth of 36 inches. Diameter of footings shall be as shown on the drawings.
- C. Securely fasten top rails to terminal posts with heavy pressed steel connection. Pass through intermediate post tops and form a continuous brace between terminal posts.

Couplings shall be outside sleeve type at least seven inches in length at approximately 20 spacing. One coupling in every five shall contain heavy spring to take up expansion and contraction to top rail.

- D. Install post braces and adjustable truss rods at corners as indicated on drawings. Connect to posts with approved fittings.
- E. Equip posts with tops. Tubular post tops designed to exclude moisture from posts.
- F. Fabric Connections: Securely fasten chain link fabric to all terminal posts by tension bars with heavy one inch by 11 gauge pressed steel bars spaced 14 inches apart, to line posts with 6 gauge wire clips spaced 14 inches apart.
- G. Gates: Weld all joints to gate frames. Gates shall be properly braced to eliminate any possible sagging condition. Hinges shall be of sufficient strength and design to permit easy and trouble-free operation. All gates shall be equipped with center plunger rods and catch with a means for padlocking, and semi-automatic outer catches to secure gates in open position.

#### **SECTION 701.10 - CLEANUP**

Upon the completion of the installation work, all debris created by the installation including excess concrete shall be removed from the project site and disposed of in a lawful manner.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 801  
MINIMUM DESIGN STANDARDS FOR CURB,  
GUTTER, SIDEWALK AND STREET CONSTRUCTION**

**SECTION 801  
MINIMUM DESIGN STANDARDS FOR CURB, GUTTER,  
SIDEWALK AND STREET CONSTRUCTION**

**SECTION 801.01 - GENERAL**

- A. All streets, both curb and gutter and borrow pit drainage shall conform to the minimum R/W width and construction type as determined below by street type and zoning.

STREET TYPE*	R/W WIDTH	DRAINAGE	SIDEWALK	SURFACE
Arterial	80'	Curb & Gutter	Yes	Paved
Collector	60'	Curb & Gutter	Yes	Paved
Local	50-60'	Curb & Gutter	Yes	Paved
Industrial (M-1 Zoning Only)	60'	Borrow Pit	No	Gravel
Rural (A Zoning only)	60'	Borrow Pit	No	Paved

\* As defined in the City of Lander, Subdivision Regulations, Section 12.

- B. In addition all curb and gutter type street construction shall conform, to the requirements of the minimum design standards set forth in tables 1 through 4 and Standard Drawings No. 609-01 and 609-02. Care shall be taken to insure continuity of grade and widths, etc. of proposed, existing and future installations.
- C. All borrow pit type streets construction shall conform to the applicable requirements of the minimum design standards set forth in Table 1 through 4 and in standard drawings No 609-03 and 609-04.

**SECTION 801.02 - GEOMETRICS AND GRADES**

- A. GENERAL - The City engineer may permit deviations from these requirements when, in his judgement, terrain conditions are such that minimum or maximum grades as set forth are not feasible. Absolute minimum grade permitted by the City engineer shall be 0.5 percent and shall be carried in continuous intervals not to exceed 100 feet as indicated by center line stationing. Center line street profiles shall be extended for future construction, beyond the limits of the project being designed, for a distance of 500 feet or to connect to an existing improved street, whichever is the lesser.

For the purpose of this standard, low, medium and high development density will be defined as follows:

- 1) Low Density: Six (6) units or less per acre
- 2) Medium Density: Seven (7) to ten (10) units per acre
- 3) High Density: Eleven (11) to thirty (30) units per acre

The City comprehensive land use map denotes these areas deemed suitable for low, medium and high density residential development.

B. **STREET DESIGN STANDARDS FOR CUL-DE-SACS AND LOOP TYPE LOCAL STREETS** - The design and improvement standards contained in the following table are minimums for cul-de-sacs and loop type streets in residential subdivisions. All such streets shall be designed and constructed in accordance with standards as specified in Table 1.

TABLE 1 STREET DESIGN STANDARDS FOR CUL-DE-SACS AND LOOP TYPE LOCAL STREETS									
Terrain classification development density	Level			Rolling			Hilly		
	Low	Med	High	Low	Med	High	Low	Med	High
Right-of-Way (ft)	50	50	60	50	50	60	50	50	60
Pavement Width (ft)(1)	36	38	40	36	38	40	36	38	40
Sidewalk Width (ft)	4	4	5	4	4	5	4	4	5
Minimum Stopping Sight Distance (ft)	150	150	150	150	150	150	150	150	150
Maximum Grade	4%	4%	4%	8%	8%	8%	10%	10%	10%
Maximum Cul-de-sac Length	700	500	500	600	500	500	500	500	500
Minimum Cul-de-sac Radius	45	48	50	45	48	50	45	48	50
Minimum Cul-de-sac Radius (Pavement)	36	38	40	36	38	40	36	38	40

- (1) Pavement width may be reduced by eight (8) feet on loop streets when one way traffic movement is proposed; Pavement width may be reduced by eight (8) feet when on street parking is restricted to one side of street.

C. **STREET DESIGN STANDARDS FOR ALL LOCAL STREETS EXCEPT CUL-DE-SACS AND LOOP TYPE STREETS** - The design and improvement standards contained in the following table are minimums for all local type streets, except cul-de-sac and loop type streets, in residential subdivisions. All such streets shall be designed and constructed in accordance with the standards as specified in Table 2 on this page.

TABLE 2 STREET DESIGN FOR ALL LOCAL STREETS EXCEPT CUL-DE-SACS AND LOOP TYPE STREETS									
Terrain Classification Development Density	Level			Rolling			Hilly		
	Low	Med	High	Low	Med	High	Low	Med	High
Right-of-Way (ft)	50	60	60	50	60	60	50	60	60
Pavement Width (ft)(1)	36	40	44	36	40	44	36	40	44
Sidewalk Width (ft)	4	4	5	4	4	5	4	4	5
Minimum Stopping Sight Distance (ft)	150	150	150	150	150	150	150	150	150
Maximum Grade	4%	4%	4%	8%	8%	8%	10%	10%	10%

1. Pavement width may be reduced by eight (8) feet when on street parking is restricted to one side of street.

D. **COLLECTOR STREET DESIGN STANDARDS** - The design and improvement standards contained in the following table are minimums for all collector streets. All such streets shall be designed and constructed in accordance with the standards as specified in Table 3. Industrial streets will be treated the same as collector streets.

TABLE 3 COLLECTOR AND INDUSTRIAL STREET DESIGN STANDARDS		

Terrain Classification Development Density	Level			Rolling			Hilly		
	Low	Med	High	Low	Med	High	Low	Med	High
Right-of-Way (ft)	60	60	60	60	60	60	60	60	60
Pavement Width (ft)(1)	40	44	44	44	44	44	44	44	44
Sidewalk Width (ft)	4	5	5	4	5	5	4	5	5
Minimum Stopping Sight Distance (ft)	200	200	200	200	200	200	200	200	200
Maximum Grade	4%	4%	4%	7%	7%	7%	8%	8%	8%
Minimum Spacing for Intersections with an Arterial (ft)	1320 feet in all these categories								
Minimum Centerline Radius	400	400	400	400	400	400	400	400	400

1. Pavements width may be reduced by eight (8) feet if on street parking is restricted to one side of street.

### **SECTION 801.03 - HORIZONTAL ALIGNMENT**

When there is an angle of deflection of more than ten (10) degrees between two (2) centerline tangent sections of a street, a curve of adequate radius shall connect them, see Specifications Table 3, Section 801.02. Between reverse curves a minimum tangent of one hundred (100) feet shall be introduced.

### **SECTION 801.04 - VERTICAL ALIGNMENT**

- A. All changes of grade shall be connected by vertical curves of a minimum length in feet equal to fifteen (15) times the algebraic differences in the rate of grade.
- B. Minimum vertical visibility shall conform to the Wyoming Department of Highways current regulations.
- C. No street grade shall be less than 0.5 percent and in no case shall a street grade be more than four (4) percent within one hundred (100) feet of an intersection.

### **SECTION 801.05 - INTERSECTIONS**

- A. The design and improvement standards for intersections are minimums for all street intersections in subdivisions. All such intersections shall be designed as constructed in accordance with the standards as specified in Table 4.
- B. Multiple intersections involving junctions of more than two (2) streets shall be avoided.
- C. Four-way intersection of local streets should be avoided and three-way T-intersections should be encouraged whenever possible.



**TABLE 4  
INTERSECTION DESIGN STANDARDS**

Terrain Classification Development Density	Level All Density	Rolling All Density	Hilly All Density
Maximum Approach Speed (MPH)	25	25	25
Clear Sight Distance (ft) (Length along each approach leg)			
Local	200	200	200
Collector	300	300	300
Vertical Alignment with Intersection	Flat	2% (Max)	4% (Max)
Minimum Angle of Intersection	60 degrees (90 degrees preferred)		
Streets shall remain in the angle of intersection for at least 100 feet beyond the point of intersection			
Minimum Curb Radius (ft)			
(a) Local-local	20 - all cases		
(b) Local-collector	25 - all cases		
(c) Collector-collector	30 - all cases		
(d) Collector, marginal access-arterial	35 - all cases		
Minimum centerline, offset of adjacent intersections (ft)			
(a) Local-local	150 - all cases		
(b) Local-collector	200 - all cases		
(c) Collector-collector	300 - all cases		
(d) Collector, marginal access-arterial	1320 - all cases		

**SECTION 801.06 - CURB AND GUTTER**

All curb and gutters shall be constructed of Portland cement concrete to the dimensions shown on City of Lander Standard Drawing No. 503-01. Roll-over curbs may be used except where the predominant grade is 6% or greater.

#### **SECTION 801.07 - SIDEWALKS**

A. **GENERAL** - All sidewalks shall be constructed of Portland cement concrete to the minimum width specified in Section 801.02, except as specified in subsection B (below) and a minimum thickness of four inches. Monolithic poured curb, gutter and sidewalk will have a minimum thickness of six (6) inches from the street to the back of the curb line, then tapering to four (4) inches at the back edge. Typical cross-section are shown in Standard Drawing No. 503.01.

B. Sidewalk width on both sides on Main Street, between First and Sixth Streets, shall be twelve (12) feet nine (9) inches, said sidewalks to extend to the property lines. Sidewalk width on both sides of Lincoln Street, between First and Fourth Streets, shall be eight (8) feet, said sidewalks to extend to the property line.

Sidewalk width on both sides of Second and Third Streets, between Lincoln and Garfield Streets, shall be eight (8) feet, said sidewalks to extend to the property line.

C. **WHEELCHAIR RAMPS** - Curb and sidewalks shall be constructed with wheelchair curb ramps at all points of intersection between pedestrian and motorized lanes of travel and no less than two (2) curb ramps per lineal block. Curb ramps will be one of the types shown in Standard Drawings 504-03 and 504.04.

**SECTION 801.08 - DRIVEWAYS** - Driveways shall have a maximum grade change of 6% within ten (10) feet. Driveways shall be a minimum of ten (10) feet wide (12 feet wide if used as an entrance walk-driveway combination) and shall be located not less than four (4) feet from the side lot line. Curb cuts shall be five (5) feet wider than the driveway pavement on each side. The minimum thickness for driveway approaches and the adjacent sidewalk section shall be six (6) inches. Both driveway and alley approaches shall be constructed as shown in Standard Drawing No. 504-02, including a one (1) inch lip for the blind shall be provided at the gutter line.

**SECTION 801.09 - ALLEY APPROACHES** - Alley approaches shall have a width of fourteen (14) and shall have a warped transition of five (5) feet on each side, as shown on City of Lander Standard Drawing No. 504-02. The minimum thickness for alley approaches and the adjacent sidewalk section shall be six (6) inches. A one (1) inch lip for the blind shall be provided at the gutter line.

## **SECTION 801.10 - URBAN STORM DRAINAGE SYSTEMS**

A. **GENERAL** - All streets shall be designed to provide continuous surface drainage directed to storm drain inlets and drainage courses. Grades shall permit flow without ponding. Six (6) foot concrete valley gutters shall normally be installed across those streets at intersections carrying traffic which must stop. Installation of valley gutters between intersections or across streets carrying through traffic at intersections shall be avoided in all possible cases. A check shall be made to be sure of continuity drainage design between the proposed construction and existing or future construction. In no case shall surface drainage be permitted to be disposed of overland except by approved storm drainage facilities.

B. **INITIAL STORM PROVISIONS** - The initial storm drainage system is necessary to reduce street maintenance costs, to provide protection against regularly recurring damage from storm runoff, to help create an orderly urban system and to provide convenience to the urban residents. The initial drainage system cannot economically carry major runoffs, though the major drainage system can provide for the initial runoff. A well planned initial drainage system can reduce or eliminate the need for storm sewer systems.

Storm sewer systems consisting of underground pipes are a part of initial storm drainage systems.

C. **MAJOR STORM PROVISIONS** - In addition to providing the storm drainage facilities for the initial storm runoff from an expected frequency of occurrence of once in five (5) years, provisions shall be made to obviate major property damage and loss of life for the storm runoff expected to occur once each 100 years. Such provisions are known as the major drainage system.

D. **MAJOR DRAINAGE CHANNELS** - Open channels for transportation of major storm runoff are desirable in urban areas and use of such channels is encouraged.

Open channel planning and design objectives are best met by using natural, or natural-type channels, which characteristically have slow velocities and a large width to depth ratio.

Natural water courses, perhaps wet only during and after large rainstorms, must not be filled or straightened significantly, such actions tend to reduce storage and increase the velocity to the detriment of those downstream as well as those adjacent to the channel work. Effort must be made to reduce flood peaks and control erosion so that the natural channel regime is preserved as much as possible.

E. **DESIGN STORM FREQUENCIES** - Storm drainage planning and design shall fully recognize the need for considering two separate and distinct storm drainage systems: that

is, the initial drainage system and the major drainage system. Design storm frequencies shall be:

LAND USE	DESIGN STORM RETURN PERIOD (YEARS)		COMPARATIVE RAIN FALL FOR ONE HOUR STORM AT LANDER AIRPORT	
	Initial Design Storm	Major Design Storm	Initial Design Storm	Major Design Storm
All	5	100	0.80"	1.58"

- F. RUNOFF COMPUTATION - The determination of storm runoff magnitude shall be by the rational formula.
1. Areas under 200 Acres - The Rational formula shall be the method used to compute the amount of storm runoff for basins less than 200 acres in size and for the sizing of storm sewer systems.
  2. Areas over 200 Acres - A unit Hydrograph Procedure shall be used for computing the amount of storm runoff for drainage areas over 200 acres in size. However, the sub-basins making up the total area, when less than 200 acres individually, may be studied using the Rational Formula.

The unit Hydrograph procedure provides a means for adequately evaluating different times of concentration from various sub-basins at a point of concentration for sizing of channels, trunk lines and outfalls.

- G. USE OF STREETS - Streets are significant and important in urban drainage and full use shall be made of streets for storm runoff up to reasonable limits, and recognizing that the primary purpose of streets is for traffic. Reasonable limits of the use of streets for transportation of storm runoff shall be governed by the design criteria listed below.

ALLOWABLE USE OF STREETS FOR INITIAL STORM RUNOFF IN TERMS OF PAVEMENT ENCROACHMENT	
Street Classification	Maximum Encroachment
Local	No curb overtopping. Flow may spread to crown of street.
Collector	No curb overtopping. Flow spread must leave at least one lane free of water.
Arterial	No curb overtopping. Flow spread must leave at least one lane free of water in each direction.

When the above encroachment is indicated, the storm sewer system shall be commenced, designed on the basis of the initial storm. Development of the major drainage system is encouraged which can often drain off the initial runoff from the streets, thus making the point at which the storm sewer system shall commence further downstream.

H. IRRIGATION DITCHES - Irrigation ditches shall not be used as outfall points for initial or major drainage systems, unless such use is shown to be without unreasonable hazard substantiated by adequate hydraulic engineering analysis.

1. Use of Ditches - Irrigation ditches through urban areas are usually laid out on flat slopes and with limited carrying capacity. It is obvious, based on experience and hydraulic calculations, that irrigation ditches cannot, as a general rule, be used as an outfall point for the initial storm drainage system because of physical limitations. Exceptions to the rule are when the capacity of the irrigation ditch is adequate to carry the normal ditch flow plus the initial storm runoff with adequate freeboard to obviate creating a hazard to those below the ditch.
2. Ditch Perpetuation - Irrigation ditches are sometimes abandoned in urban areas after the agricultural land is no longer farmed. Provisions must be made for ditch perpetuation prior to its being chosen and used as an outfall for urban drainage.

**SECTION 801.11 - FLEXIBLE PAVEMENTS** - Flexible pavement shall consist of full depth asphaltic concrete or a combination of asphaltic concrete and granular base course. Pavement thickness shall be determined by use of underlying soil and traffic analysis. This analysis shall be done by a recognized soils testing laboratory and method under the direction of Professional Engineers. Samples for determination shall be made at the proposed subgrade elevation. Traffic volumes and truck loadings shall be determined by the City engineer and the design method shall be the asphalt institute thickness design. If another method of thickness design is used, the

engineer must show that the selection design thickness procedure does not result in a lesser pavement section. Test results shall be interpreted in such a manner as to insure adequate pavement thickness in all cases. Where testing indicates the minimum thickness may be used, these values are as follows. Full depth thickness shall be taken as six (6) inches minimum for collector and five (5) inches minimum for local streets. Minimum thickness of base and asphaltic pavement combinations shall be two and one half (2 1/2) and two (2) inches asphaltic pavements and eight (8) and six (6) inches granular base for collector and local streets respectively. Industrial gravel surfaced streets shall have a minimum of twelve (12) inches of gravel.

The combination of paving, base and subexcavated subgrade shall be designed for a stable street grade. Construction fabrics may be used in this design to substitute for a portion of any otherwise subexcavated and backfilled subgrade.

**CITY OF LANDER  
STANDARDS AND SPECIFICATIONS  
SECTION 802  
MINIMUM DESIGN STANDARDS FOR  
WATER DISTRIBUTION SYSTEM**

**SECTION 802**  
**MINIMUM DESIGN STANDARDS FOR**  
**WATER DISTRIBUTION SYSTEM**

**SECTION 802.01 - DESIGN FLOW** - The design of the water distribution system shall be based on the following:

Peak daily residential per capita demand 500 gallons per day. Peak daily industrial demand must be approved by the City engineer. Peak primary and secondary feeders shall be designed for a flow of 9 gpm per acre. Residential areas require 1500 gpm for fire flow which may be from more than one fire hydrant, providing the additional fire hydrants are accessible to any possible fire location. In industrial and commercial areas of continuous buildings and multi-family residential, fire flow of 2500 gpm shall be made available for the area or as approved by the City engineer.

**SECTION 802.02 - PRESSURE REQUIREMENTS** - All areas shall be designed to have a maximum static head of 250 feet (108 psi) and a minimum static head of 100 feet (43 psi). Distribution systems shall also be designed to maintain a 20 psi residual pressure during required fire flow and a 35 psi residential residual during peak residential flows.

**SECTION 802.03 - FIRE HYDRANT SPACING** - In single family residential areas hydrants shall be spaced not more than 500 feet apart when measured along the street curb line and at an overall spacing that will average not less than one hydrant to 150,000 square feet throughout an individual subdivision. A hydrant shall be placed in the end of each cul-de-sac over 300 feet in length. Fire hydrants shall be located on the northwest corner of intersections if possible.

In business, industrial and multi-family areas, hydrants shall be spaced not greater than 350 feet apart and shall cover not more than an average of 110,000 square feet per hydrant.

**SECTION 802.04 - PIPE SIZE AND SPACING** - Primary feeder lines shall be 12 inch pipe or larger and spaced at maximum one mile intervals with secondary feeders being 8 inch pipe or larger and spaced 1/4 mile intervals or less, subject to the approval of the City engineer. Distribution mains shall be six inch pipe where the length of the main between branches is less than 800 feet and the distance to any fire hydrant is less than 250 feet, otherwise 8 inch pipe shall be used. All piping shall be looped. Mains at ends of cul-de-sacs shall be looped along lot lines to adjacent streets. Dead ends on any lines that will be tapped for service before being extended, shall be provided with a temporary blow-off or fire hydrant for flushing purpose. Flushing devices shall be sized to provide flows which will give a velocity of 2.5 feet per second minimum in the water main being flushed. No flushing device shall be directly connected to any sewer. All properties to be served water shall have a main adjacent to the property.

**SECTION 802.05 - VALVE SPACING** - Gate valves shall be placed with a maximum length of line required to be out of service at one time or not be more than 500 feet for commercial districts nor more than one block or 800 feet for other districts. Valves shall also be placed at



each fire hydrant and permanent blow-off. Typically, every intersection will have at least two valves, and more where required, to allow for the least number of homes being out of service at one time. Valves shall be spaced so as to have no more than 12 units without water during a water main break.

Valves shall be provided at both ends of water crossings, that are greater than 15 feet wide so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding.

**SECTION 802.06 - AIR/VACUUM AND RELIEF VALVES** - In all transmission lines and in distribution lines 16 inches and larger at high points (where the water pipe crown elevation falls below the pipe invert elevation), provisions shall be made for air relief. Fire hydrants or active service taps may be substituted for air/vacuum relief valves on six and eight inch lines. Manholes or chambers for automatic air relief valves shall be designed to prevent submerging the valve with groundwater or surface water.

**SECTION 802.07 - HYDRAULIC DESIGN** - All pipes shall be designed to have a maximum velocity to 10 feet per second. Distribution mains shall be designed using a Hazen-Williams friction coefficient "C" equal to 100. Primary feeders may be designed using a "C" of 130, (for PVC pipe use an H & W coefficient of 150).

**SECTION 802.08 - PIPE MATERIALS** - In general, all pipe used in distribution systems shall be either ductile iron, or PVC. See City of Lander Standards and Specifications, (Section 301, Water Mains), for details of pipe and installation.

**SECTION 802.09 - LOCATION DETAIL** - In all instances, the water mains shall extend to the extremities of the property or subdivision served. A main serving one lot shall extend all the way across the frontage for that lot. Mains serving a subdivision shall extend to the center of boundary streets or to boundary lines.

**SECTION 802.10 - COVER** - All water mains shall be installed with a minimum of 6.5 feet of compacted cover between the finished grade of the street and the top of the pipe barrel.

**SECTION 802.11 - SERVICE CONNECTIONS** - Water service lines shall be located approximately at the center of each lot or building site and shall be shown on the plans. The service line shall be located a minimum of ten (10) feet on the horizontal plane from the sanitary sewer service line, with 6.5 feet minimum cover.

Service stub-ins for residential installations shall terminate at a curb stop with the box 3.5 feet behind the curb, set flush in the sidewalk. On machine placed sidewalks the curb box may be located 6.0 feet behind the curb.

**SECTION 802.12 - MATERIAL ADDITIONS** - The City of Lander has the right to require an addition of valves, hydrants and other appurtenances by the developer or owner up until the time

of completion of the water construction portion of the development.

**SECTION 802.13 - CORROSION PROTECTION** - Gray and ductile iron pipe used for water and sewage shall be protected from corrosion where needed, as indicated by soil test evaluations summarized in the following table:

TABLE 1 Soil Test Evaluation *	
Soil characteristics	Points
Resistivity - ohm-cm (based on single probe at pipe depth or water-saturated Miller soil box):	
Less than 700	10
700 - 1,000	8
1,000 - 1,200	5
1,200 - 1,500	2
1,500 - 2,000	1
More than 2,000	0
pH:	
0-2	5
2-4	3
4-6.5	0
6.5-7.5	0+
7.5-8.5	0
More than 8.5	3
Redox Potential:	
More than +100 mV	0
+50 to =100 mV	3.5
0 to =50 mV	4
Negative	5

Sulfides:	
Positive	3.5
Trace	2
Negative	0
Moisture:	
Poor drainage, continuously wet	2
Fair drainage, generally moist	1
Good drainage, generally dry	0

- \* Ten points - corrosive to gray or ductile cast-iron pipe; protection is indicated.
- + If sulfides are present and low or negative Redox potential results are obtained, three points shall be given for this range.

Additional information is available, in the American National Standard ANSI/AWWA C105-77, which is available from the American Water Works Association, 6666 W Quincy Avenue, Denver, Colorado 80235. Soil Samples may also be sent to the Ductile Iron Pipe Research Association, 10920 East Dowers Court, Englewood, Colorado 80111 for evaluation.

**CITY OF LANDER, WYOMING  
STANDARDS AND SPECIFICATIONS  
SECTION 803  
MINIMUM DESIGN STANDARDS FOR  
SANITARY SEWERS**

**SECTION 803  
MINIMUM DESIGN STANDARDS FOR  
SANITARY SEWERS**

**SECTION 803.01 - DESIGN FLOW** - The design shall include consideration of providing service for the entire area tributary to the outfall point. Estimates of residential sewage contribution shall be based on 100 gallons per capita per day with a peak hour factor of 3.5.

RECOMMENDED SEWER REQUIREMENTS		
RESIDENTIAL LANDER USE	UNIT DENSITY	EQUIVALENT POPULATION
Single Family	2.5 Dwellings/Acre	8.8 persons/acre
Mobile Home	6 Dwellings/Acre	21 persons/acre
Multi-Family	15 Dwellings/Acre	52.5 persons/acre
COMMERCIAL LAND USE	18 persons/acre	
INDUSTRIAL LAND USE		
Heavy	15 persons/acre	
Light	10 persons/acre	

**SECTION 803.02 - HYDRAULIC DESIGN** - Sewers 10 inches in diameter and smaller shall carry the design flow at a maximum flow depth of three quarters (75%) of the pipe diameter. Trunk sewers 12 inches in diameter and larger may be designed to flow full at the design flow rate. The minimum velocity at the design flow rate shall be 2.0 feet per second. Where actual flow will be much below normal for several years the minimum velocity shall be achieved by suitable grades at the partial design flow rate. Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. Maximum allowable velocity shall not exceed 10 ft./sec. at three-quarters full.

**SECTION 803.03 - DESIGN DETAILS** - Sanitary sewer mains shall ordinarily be 8 inch diameter or larger. Service connection shall be 4 inch diameter or larger. The following minimum grades shall apply unless requirements of Paragraph 2 govern.

SEWER DIAMETER	MINIMUM GRADE (PERCENT)
4 inch	1.2 or 1/4 inch per foot
6 inch	0.64
8 inch	0.40
10 inch	0.28
12 inch	0.22
15 inch or larger	Min. Velocity of 2 tf./sec.

Manholes shall be provided at every change in direction, grade or connection with other sewer mains; maximum spacing shall be 400 feet for lines 15 inches or smaller, or 500 feet for lines 18 inches and larger. Maximum change of direction in manholes for lines 18 inches and larger shall be 45 degrees. Sewer lines shall be straight and not curved between manholes, both in line and grade. Cleanouts may be provided instead of a manhole at dead-ends if the total length above the last manhole is less than 100 feet and a maximum of three residential connections are to be made. Drop manholes shall be designed according to the drawing in The City of Lander Standard Drawing 401-01.

In general, sewer mains shall have a minimum of 8 feet of cover between top of pipe and finished ground surface. Where this will provide less than 9 feet of elevation difference between the finished lot grade at building line and the top of the sewer main, it shall be indicated on the plans that the lot is served by a "shallow sewer" and appropriate elevation information shall be given.

Sewer mains shall be extended to a point at least 10 feet uphill from the lowest lot corner adjacent to the sewer main of the uppermost lot to be served and terminate in a cleanout or manhole. Service connections shall not be made at manholes but shall be provided above or below the manhole as required, unless approved by the City Engineer. Manholes shall be stubbed out with suitable size pipe and plugged wherever future lateral extension of the sewer is anticipated.

**SECTION 803.04 - CONSTRUCTION DETAILS** - All sanitary sewer mains shall be bedded in well-graded sand or sand gravel mixtures having a maximum size of 1 1/2 inches. Poorly graded gravel shall have a maximum size of 3/4" may be used at the direction of the Engineer. Migration of fines, from the backfill into the poorly graded gravel had been a problem in the past, and it is desirable to minimize their use of installed without a filter. Bedding shall extend from three (3) inches below the pipe to twelve (12) inches above the pipe. The bedding material shall be distributed by hand in maximum layers of six (6) inches and thoroughly compacted by tamping. When wet, unstable trench bottoms exist, a minimum of 6" additional bedding shall be

installed below the normal three (3) inches of bedding.

Where sewer pipe has less than four feet of cover, provision shall be made to protect the pipe from impact loading. Where design velocities exceed 10 feet per second, special provisions shall be made to protect against pipe displacement by erosion and shock.

**SECTION 803.05 - SERVICE CONNECTIONS** - Wyes shall be provided in the sewer main for service connections at each lot or building site and shall be shown on the plans. These fittings shall ordinarily be located 10' from lower side of lot and a minimum of ten (10) feet on the horizontal plane from the water service line. Fittings shall be angled upwards so that the upper invert of one-eighth bend connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. Riser connections shall be installed where the elevation of the top of the fitting is more than 12 feet below finished ground. Riser connection shall ordinarily reach to a grade 10 feet below finished ground surface. See City of Lander Standards and Specifications for Sanitary Sewer Services for details on service stub-in and house service connections.

# **STANDARD DRAWINGS**