

**CITY OF LONGMONT
SECTION 300 - STORM DRAINAGE IMPROVEMENTS
TABLE OF CONTENTS**

300.00 DESIGN CRITERIA	1
300.01 SUBMITTALS	2
301.00 STORM DRAINAGE IMPROVEMENTS.....	3
301.01 GENERAL.....	3
301.02 REINFORCED CONCRETE PIPE MATERIAL	4
301.03 REINFORCED CONCRETE BOX CULVERTS AND INLET MATERIAL	5
301.04 NON-REINFORCED CONCRETE PIPE MATERIAL	5
301.05 POLYVINYL CHLORIDE (PVC) PIPE MATERIAL	6
301.07 A-2000 PVC STORM SEWER PIPE	7
301.08 ALUMINIZED STEEL ULTRA FLO STORM SEWER PIPE – 16 GAGE OR THICKER.	8
301.09 ALUMINUM ULTRA FLO STORM SEWER PIPE – 14 GAGE OR THICKER.....	8
301.10 POLYMERIC ULTRA FLO STORM SEWER PIPE – 16 GAGE OR THICKER.....	9
301.11 MANHOLE MATERIAL	9
301.12 END SECTION AND OUTFALL MATERIAL	10
301.13 INSTALLATION OF PIPE AND APPURTENANCES	10
301.14 CONSTRUCTION OF MANHOLES	10
301.15 CONSTRUCTION OF STORM WATER INLETS AND STRUCTURES	11
301.16 TESTING AND FLUSHING PIPE	12
301.17 VIDEO OF COMPLETED STORM SEWER PIPE	12

**SECTION 300 - STORM DRAINAGE IMPROVEMENTS
INDEX OF DETAILS**

300-01	Typical Pipe Bedding
300-02	Standard Manhole
300-03	Standard Manhole Cover
300-04	Type "R" Inlet Access Location
300-05	Manhole Cover Location
300-6A	Standard Flared End Section
300-6B	Elliptical Flared End Section
300-6C	Flared End Section Trash Rack (Circular Pipe)
300-6D	Trash Rack Mounting (Circular Flared End Section)
300-6E	Flared End Section Trash Rack (Elliptical Pipe)
300-6F	Trash Rack Mounting (Elliptical Flared End Section)
300-07	Silt Fence Erosion Barrier
300-08	Straw Bale Erosion Barrier
300-09	Construction Staging Pad

STORM DRAINAGE IMPROVEMENTS

300.00 DESIGN CRITERIA

1. The minimum design standards shall be in accordance with this section or the City of Longmont Storm Drainage Criteria Manual, latest edition, in that order.
2. Offsite drainage calculations must be included in the drainage reports. These calculations will include both upstream and downstream areas. Subdivisions and other properties are required to provide facilities to pass upstream runoff through the site without exceeding street, storm sewer, or channel capacities. If downstream improvements have not been installed, upstream subdivisions are responsible to make improvements to reach the major drainage way.
3. On-site drainage calculations will include hydrology (minor storm: 2-year for residential, 5-year for commercial/industrial, and major storm: 100-year for all), runoff calculations at specific design points, street capacity calculations, inlet and storm sewer calculations, channel and erosion designs, and detention storage for 10-year and 100-year design storms.
4. The hydrology method for areas less than 100 acres will be the Rational Method. Areas greater than 160 acres will be calculated using Colorado Urban Hydrograph Procedure for basin hydrographs and the Storm Water Management Model for routing. The basins between 100 and 160 acres may use either method. Areas larger than 130 acres typically require a maintained channel or storm sewer to accommodate nuisance flows and deter erosion.
5. The design for storm drainage runoff street capacity is limited to no curb overtopping for minor storms, including one open lane for local commercial/industrial and collector streets, and two open lanes for arterial streets. Street capacity during major storms are limited to twelve (12) inch depth at gutter flowline and six (6) inch maximum depth at the crown of arterial streets. Street capacity for major storms must also be limited to stay within the street right-of-way.
6. All major drainage way channel improvements should be discussed with the Parks Division prior to submittal of public improvement plans. Many channels are designated as greenways and must follow those specifications. The creek itself may include trees that the City may wish to save. Responsibility of maintenance must be determined during the review process. Construction of the channel improvements is the sole responsibility of the property adjacent to the channel unless private agreements are reached. The channel will be constructed according to a design following Section 700 of Longmont Storm Drainage Criteria Manual.
7. Bridges will be designed for the 10-year design storm for local and collector streets and the 100-year design storm for arterial streets. Subdivisions that need additional capacity to remove land from the floodplain, are responsible to provide that capacity.
8. Storm sewers will be provided when the street capacity exceeds the allowable street flow for either the minor or major storm. The location of the storm sewer shall typically be under the asphalt, ten (10) feet south or east of the street centerline.

9. Crossspans are not acceptable in through collector or arterial streets. Crossspans may be acceptable at intersections with stop signs and no potential for street light signalization.
10. Crossspans and rundowns are not acceptable for delivering minor storm runoff from a street to a detention pond. Inlets and storm sewers must be provided.
11. 100-year storm runoff overflow channels between buildings will include a minimum thirty (30) foot wide drainage easement, typically centered on the property line. Storm sewers constructed in these easements will be offset five (5) feet from the property line.
12. Subdivisions with lots less than one (1) acre must provide detention for the entire subdivision. Lots greater than one (1) acre may be assigned individual detention responsibilities.
13. Detention ponds will be privately maintained unless agreed to otherwise in the Public Improvement Agreement. Detention ponds are defined to include the outlet structure and outlet release pipeline until it reaches a City storm sewer manhole.
14. Detention Pond sizes will be calculated with the equation $V = KA$ where:

For the 100-year, $K_{100} = (1.78I - 0.002I^2 - 3.56) / 1000$

For the 10-year, $K_{10} = (0.95I - 1.90) / 1000$

Where V = required volume for the 100- or 10-year storm (acre-feet)

I = Developed basin imperviousness (%)

A = Tributary Area (Acres)

Maximum release rates are limited to:

$Q_{100} = 1.0A$

$Q_{10} = 0.24A$

For detention ponds in series or release rates less than maximum, a calibrated FAA mass diagram method may be used to calculate volume.

300.01 SUBMITTALS

1. Two (2) copies of the preliminary drainage report are required to be submitted with the preliminary plat. The applicant is responsible to submit copies of the report to any irrigation ditch company or agency that may be affected by the proposed project. The preliminary drainage report will include hydrology for on-site and tributary off-site area's, proposed flow routes including estimated locations for inlet and storm sewer placement, and calculations for detention requirements and proposed detention pond configurations. The preliminary drainage report must be approved prior to approval of the preliminary plat.
2. Two (2) copies of the final drainage report are required to be submitted with the final plat submittal. The applicant is responsible to submit copies of the report to any irrigation ditch

company or agency that may be affected by the proposed project. The final drainage report will include the updated information from the preliminary report and hydraulic calculations for all drainage improvements. The final drainage report must be approved prior to approval of the final plat and the construction drawings.

301.00 STORM DRAINAGE IMPROVEMENTS

301.01 GENERAL

1. This section of the specifications covers the furnishing and installing of all storm drainage improvements, storm sewers, storm water inlets, manholes, headwalls, other appurtenances and all related work necessary to complete the storm drainage improvements. Trenching and backfill shall be done in accordance with the requirement of the General Requirements Section of the Standard Specifications under "Trenching".
2. All piping and material shall be of the type and materials specified herein. The use of materials other than those specified herein require approval from the engineer. All materials shall be new and unused. All pipe sizes and references to pipe diameter on the drawings or in the specifications are intended to be the nominal inside diameter, and shall be interpreted as such. Pipe inside diameter shall be 18 inches and larger for public storm sewers. Pipe inside diameter shall be fifteen (15) inches and larger for private storm sewers that are connecting to public manholes. All pipe will have a minimum of two (2) feet of cover from the subgrade under the asphalt and base course to the top of the bell of the pipe.
3. The work covered by this section will not be accepted until the backfill connected with the work has been completed satisfactorily. Any section of storm sewer line that is found defective in tests, material, alignment, grade, or joints shall be corrected.
4. The contractor shall provide a copy of the manufacturer's installation recommendations for each type of pipe to each foreman and inspector prior to construction. These installation recommendations shall be followed during construction unless otherwise allowed by the engineer. These specifications requirements take priority over the manufacturers installation recommendations.
5. The extensions of storm drainage pipe shall be of the same material as the existing culvert. The physical connection to the existing storm drain system shall be plugged at the first downstream manhole until the storm system has been completed to the satisfaction of the engineer.
6. When a storm drain line is anticipated to be extended at a future date, the contractor shall install a manhole at the end of the line and shall install plugged stub out(s) in the direction(s) of the extension.
7. The contractor shall locate manholes at all changes in grade, alignment, pipe materials, and pipe sizes. For changes in pipe size, the crowns of the pipes shall be at the same elevation, or the incoming flow shall be 0.2 feet above the outgoing flow, whichever is the greater drop across the manhole invert. The storm piping may not be curved. Manholes shall be located at street intersections whenever possible.

8. The engineer reserves the right to require the testing of pipe and materials after delivery and to reject all pipe or materials represented by the sample which fail to comply with the specified requirements.

301.02 REINFORCED CONCRETE PIPE MATERIAL

1. Reinforced concrete pipe may be used on storm sewer projects under the pavement within City right-of-way.
2. Circular reinforced concrete pipe shall meet the requirements of ASTM C76 and the requirements contained in the wastewater collection specifications. The use of elliptical reinforcing will only be allowed if approved by the engineer. Pipe laying lengths shall be a minimum of 7'-6". The class of pipe shall be as indicated on the approved plans. The pipe strength shall be a minimum of Class III. Bedding for concrete pipe will be a minimum of six (6) inches below the pipe to springline or the midpoint of the pipe.
3. Gaskets shall be rubber O-ring type per ASTM C 361 and ASTM C 443. Gaskets will be used in a bell and spigot joint. A Type 4-G Gasket is an acceptable substitute for an O-ring joint.
4. Arch culvert reinforced concrete pipe shall meet the requirements of ASTM C 506 and the requirements contained herein.
5. Elliptical reinforced concrete pipe shall meet the requirements of ASTM C 507 and the requirements contained herein.
6. All RCP shall be constructed with Type II modified cement. The absorption of the concrete pipe shall not exceed 5.5%.
7. Each pipe joint shall conform to ASTM C 361, Section 8, with the gaskets confined in a groove cast in the pipe spigot. Pipe with collars in lieu of integral cast bells will not be accepted. The pipe joints shall be designed to withstand, without cracking, the gasket compression plus a differential load across the joint equal to 4,000 pounds per foot of inside diameter.
8. Each piece of reinforced concrete storm drain pipe shall be plainly and permanently marked showing the pipe class, date of manufacture, and the manufacturer's name or mark. These markings shall be made on the outside of the pipe before curing or shall be painted on the pipe using waterproof paint.
9. The engineer may require the submittal of reports covering joint leakage, joint shear, cement mill reports, and three edge bearings on each size and class of pipe for review before any pipe is installed in the field. The tests for joint leakage, joint shear, and three-edge bearing are for proof of design only. Reports covering tests made on other pipe of the same size, class, and design as specified herein, and manufactured from materials of equivalent type and quality are generally acceptable.
10. The engineer may require the submittal of drawings, specifications, and other data showing complete details of the design, fabrication, and construction of the reinforced concrete pipe for review. These submittals shall include data on all materials proposed to

be used in the pipe, the size and location of each cage of the reinforcement, joint details including reinforcement, gasket details, and test results on materials, joints, and pipe.

301.03 REINFORCED CONCRETE BOX CULVERTS AND INLET MATERIAL

1. Reinforced concrete box culverts may be used on storm sewer projects under the pavement within City right-of-way.
2. Reinforced concrete box culverts shall conform to the requirements of ASTM C 789 or C 850.
3. Inlet grates in streets, alleys, and areas with pedestrians shall be of a design that is safe for bicycles and pedestrians.
4. Structures, detention outlets, and inlets shall be reinforced as per the approved plans. All structures shall have steel rebar reinforcement to prevent shrinkage.
5. Type 13 inlet grates are to be the smaller version (Neenah Model R-3246-1 or Deeter Model 2045) with a 17.75" x 36" grate with a minimum 1.8 square foot opening.
6. Access covers and steps shall be provided for all inlets. Access covers shall have the words "Storm Sewer, Confined Space, Entry Permit Required" cast on the cover. Access covers will be sized for twenty four (24) inch diameter openings, one (1) inch thick, designed for traffic loading. Access covers will be located above the pipelines so the City's jetting equipment can access the pipelines.
7. All inlets shall be cast-in-place.

301.04 NON-REINFORCED CONCRETE PIPE MATERIAL

1. Non-reinforced concrete pipe may be used on storm sewer projects which are not under the pavement within City right-of-way.
2. Non-reinforced concrete pipe may be allowed if approved by the engineer. Pipe shall be a minimum of 7'-6" in length. Class of pipe shall be as indicated on the drawings.
3. Non-reinforced concrete pipe shall conform to the requirements of AASHTO M 86 for the required diameters and strength classes. Joints shall be integral bell and spigot type joints with the gaskets confined in a groove cast in the pipe spigot.
4. Gaskets shall be rubber neoprene gaskets, ASTM C 443, or O-ring rubber type, ASTM C 361, and shall be used in the bell and spigot joint.
5. All pipe shall be constructed with Type II modified cement. The absorption of the concrete pipe shall not exceed 5.5%.
6. Each piece of pipe shall be plainly and permanently marked showing the pipe class, date of manufacture, and the manufacturer's name or mark. These markings shall be made on the outside of the pipe before curing or shall be painted on the pipe using waterproof paint.

7. The engineer may require the submittal of reports covering joint leakage, joint shear, cement mill reports, and three edge bearings on each size and class of pipe for review before any pipe is installed in the field. The tests for joint leakage, joint shear, and three-edge bearing are for proof of design only. Reports covering tests made on other pipe of the same size, class, and design as specified herein, and manufactured from materials of equivalent type and quality are generally acceptable.
8. The engineer may require the submittal of drawings, specifications, and other data showing complete details of the design, and fabrication for review. These submittals shall include data on all materials proposed to be used in the pipe, joint details, gasket details, and test results on materials, joints, and pipe.

301.05 POLYVINYL CHLORIDE (PVC) PIPE MATERIAL

1. Polyvinyl Chloride (PVC) Pipe may be used on storm sewer projects under the pavement within City right-of-way.
2. Polyvinyl chloride pipe shall meet the requirements contained in wastewater collection specifications.
3. All sizes of PVC pipe shall be SDR 35 or better, and shall have the A.S.T.M. specification, nominal diameter, and name or trade mark of the manufacturer imprinted on the outside of the pipe.

301.06 CORRUGATED HIGH DENSITY POLYETHYLENE PIPE

1. Corrugated high density polyethylene Pipe (HDPE) may be used on storm sewer projects which are not under the pavement within City right-of-way.
2. Corrugated high density polyethylene pipe (HDPE) shall be manufactured in accordance with AASHTO M294, or MP7. Clean reworked material may be used.
3. Type S pipe shall be used for storm sewer projects. Type S pipe has a full circular cross section, with an outer corrugated pipe wall and a smooth inner liner.
4. The minimum parallel plate stiffness values when tested in accordance with ASTM D2412 shall be as follows:

Diameter (nominal)	Pipe Stiffness (minimum) (pii)
12"	50
15"	42
18"	40
24"	34
30"	28
36"	22
42"	20
48"	18
60"	14

5. Watertight joints shall meet a laboratory test pressure of 10.8 psi per ASTM D3212 and shall have a bell and spigot or bell-bell design with an elastomeric gasket meeting the requirements of ASTM F477
6. Pipe and resin producers shall be certified according to the Plastic Pipe Institute/Corrugated Polyethylene Pipe Association Third Party Certification Program. All corrugated polyethylene pipe, twelve (12) inches in diameter and larger, shall contain the appropriate program mark, either an official label or permanent affixation prior to shipment.
7. All pipe shall be clearly marked at intervals no more than ten (10) feet with manufacturers name or trademark, nominal size, AASHTO specification designation, plant designation code, and date of manufacture or code.

301.07 A-2000 PVC STORM SEWER PIPE

1. A-2000 PVC storm sewer pipe may be used on storm sewer projects which are not under the pavement within City right-of-way.
2. This specification includes materials, test methods and installation requirements for four (4) to thirty six (36) inch diameter polyvinyl chloride (PVC) corrugated pipe with a smooth interior. The requirements of this specification are intended to provide pipe and fittings suitable for underground use in non-pressure applications such as irrigation, sanitary sewers, storm sewers, drainage and under drains.
3. PVC corrugated pipe with a smooth interior shall conform to the requirements of ASTM Designation F949, F794 Dual Wall Corrugated Profile (DWCP), or AASHTO M304 (latest revision). Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Pipe shall be manufactured to 46 psi stiffness when tested in accordance with ASTM Test Method D2412. There shall be no evidence of splitting, cracking or breaking when the pipe is tested per ASTM Test Method D2412 at 60% flattening. The pipe shall be made of PVC compound having a minimum cell classification of 12454B as defined in ASTM Specification D1784.
4. All fittings for PVC corrugated pipe with a smooth interior shall conform to ASTM F949, Section 5.2.3. To insure compatibility, the pipe manufacturer shall provide all fittings.
5. All joints shall be made with integrally-formed bell and spigot gasketed connections. The manufacturer shall provide documentation showing no leakage when gasketed pipe joints are tested in accordance with ASTM Test Method D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM Designation F477.
6. Pipe shall have a minimum pipe stiffness as follows:

Diameter	Stiffness (#/in/in)
12"	46
15"	46
18"	46
21"	46
24"	46
30"	46
36"	46

301.08 ALUMINIZED STEEL ULTRA FLO STORM SEWER PIPE – 16 GAGE OR THICKER, pH 5-9, RESISTIVITY GREATER THAN OR EQUAL TO 1500 ohm-cm

1. Aluminized Steel Ultra Flo Storm Sewer Pipe may be used on storm sewer projects outside from under the pavement within City right-of-way.
2. This specification covers the manufacture and installation of the Type 2 ALUMINIZED ULTRA FLO pipe detailed in the project plans.
3. The Type 2 ALUMINIZED STEEL coils shall conform to the applicable requirements of AASHTO M274 or ASTM A929.
4. The ULTRA FLO shall be manufactured with the ¾" x ¾" x 7-1/2" external ribs in accordance with the applicable requirements of AASHTO M-36 or ASTM A760. The pipe sizes, gauges and corrugations shall be as shown on the project plans.
5. The handling and assembly shall be in accordance with National Corrugated Steel Pipe Association's (NCSPA) recommendations.
6. The installation shall be in accordance with AASHTO Standard Specifications for Highway Bridges, Section 26, Division II or ASTM A798 and in conformance with the project plans and specifications. If there are any inconsistencies or conflicts, the contractor must bring them to the attention of the project engineer. It is always the contractors' responsibility to follow OSHA guidelines for safe practices.
7. Construction loads may be higher than final loads, follow the manufacturer's or NCSPA's guidelines.

301.09 ALUMINUM ULTRA FLO STORM SEWER PIPE – 14 GAGE OR THICKER, pH 4-9, RESISTIVITY GREATER THAN OR EQUAL TO 500 ohm-cm

1. Aluminum Ultra Flo storm sewer pipe may be used on storm sewer projects which are not under the pavement within City right-of-way.
2. This specification covers the manufacture and installation of the Type 2 ALUMINIZED ULTRA FLO pipe detailed in the project plans.
3. The Type 2 ALUMINIZED STEEL coils shall conform to the applicable requirements of AASHTO M197 or ASTM A744.

4. The ULTRA FLO shall be manufactured with the $\frac{3}{4}$ " x $\frac{3}{4}$ " x 7-1/2" external ribs in accordance with the applicable requirements of AASHTO M-196 or ASTM A745. The pipe sizes, gauges and corrugations shall be as shown on the project plans.
5. The handling and assembly shall be in accordance with manufactures recommendations.
6. The installation shall be in accordance with AASHTO Standard Specifications for Highway Bridges, Section 26, Division II or ASTM A788 and in conformance with the project plans and specifications. If there are any inconsistencies or conflicts, the contractor must bring them to the attention of the project engineer. It is always the contractors' responsibility to follow OSHA guidelines for safe practices.
7. Construction loads may be higher than final loads, follow the manufacturer's or NCSPA's guidelines.

301.10 POLYMERIC ULTRA FLO STORM SEWER PIPE – 16 GAGE OR THICKER, pH 5-9, RESISTIVITY GREATER THAN OR EQUAL TO 1500 ohm-cm

1. Polymeric Ultra Flo storm sewer pipe may be used on storm sewer projects which are not under the pavement within City right-of-way.
2. This specification covers the manufacture and installation of the polymer coated ULTRA FLO pipe detailed in the project plans.
3. The polymer coated STEEL coils shall conform to the applicable requirements of AASHTO M246 or ASTM A742.
4. The ULTRA FLO shall be manufactured with the $\frac{3}{4}$ " x $\frac{3}{4}$ " x 7-1/2" external ribs in accordance with the applicable requirements of AASHTO M-245 or ASTM A762. The pipe sizes, gauges and corrugations shall be as shown on the project plans.
5. The handling and assembly shall be in accordance with NCSPA's recommendations.
6. The installation shall be in accordance with AASHTO Standard Specifications for Highway Bridges, Section 26, Division II or ASTM A798 and in conformance with the project plans and specifications. If there are any inconsistencies or conflicts, the contractor must bring them to the attention of the project engineer. It is always the contractors' responsibility to follow OSHA guidelines for safe practices.
7. Construction loads may be higher than final loads, follow the manufacturer's or NCSPA's guidelines.

301.11 MANHOLE MATERIAL

1. Manholes shall be constructed as specified under these specifications. Drop manholes are allowed for storm drainage improvements. No outside drops are allowed on manholes and the engineer may restrict the difference in height between the incoming pipe invert and the outgoing pipe invert.
2. No manholes may be located in areas where ponding or storm detention basins are to be used. Manholes must be spaced no farther apart than four hundred (400) feet for pipes

with inside diameters of fifteen (15) inches to thirty six (36) inches, and five hundred (500) feet apart for pipes with inside diameters of forty two (42) inches and larger.

3. Manholes shall be at least forty eight (48) inches diameter for pipes between fifteen (15) inches to thirty six (36) inches diameter. Manholes shall be at least sixty (60) inches diameter for pipes between forty two (42) inches to forty eight (48) inches diameter. Manholes shall be at least seventy two (72) inches diameter for pipes between fifty four (54) inches to sixty (60) inches diameter. Manholes shall have a box base or precast tee for pipes larger than sixty (60) inches diameter.
4. Manhole covers shall have the words "Storm Sewer, Confined Space, Entry Permit Required" cast on the cover.

301.12 END SECTION AND OUTFALL MATERIAL

1. All storm sewers end sections and outfalls shall have a cast-in-place reinforced concrete headwall or a premanufactured flared end section as approved by the engineer. Premanufactured end sections shall be manufactured of the same materials as the pipe to which they are connected and shall meet the minimum material specifications applying to the pipe.
2. All storm sewer openings that are larger than eighteen (18) inches or subject to unauthorized entrance or trash accumulation will have a designed trash rack with a galvanized coating.

301.13 INSTALLATION OF PIPE AND APPURTENANCES

1. All pipe, fittings, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to the pipe. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to being lowered into the trench. All foreign matter or dirt shall be removed from the interior of the pipe and the accessories before lowering into the trench. The pipe shall be kept clean by means approved by the Engineer during and after installation.
2. Pipe shall be laid to a true line and at uniform rates of grade as shown on the approved plans. Fine grading of the trench shall proceed ahead of pipe laying.
3. Pipe laying should proceed upgrade with the spigot ends of the pipe pointed in the direction of flow. The contractor shall make all pipe connections to the manholes. When connecting to existing storm drains, the contractor shall take every precaution necessary to prevent dirt or debris from entering the existing storm drainage system.
4. Bedding material shall meet the requirements of Section 112.02, and shall be properly placed in accordance with Section 112.03 of these Standard Specifications.

301.14 CONSTRUCTION OF MANHOLES

1. Manholes shall be constructed as specified under the Storm Drainage Improvements Specifications.

2. Manhole covers shall be lined up with the pipeline inlet and outlet to allow the maintenance jetting equipment access to the pipelines.
3. Manholes shall be located in areas which are not subject to flooding from surface runoff. If the possibility of surface runoff cannot be avoided a solid manhole cover, having an integral O-ring type gasket, that can be bolted closed, must be used.
4. Manholes shall be located in areas which allow direct access via all-weather drives by maintenance vehicles.
5. All manholes located outside the dedicated street right-of-way or within the 100-year flood plane shall be designed and constructed with a watertight, bolted type cover and the manhole ring shall be bolted to the manhole cone.
6. Manholes will be located under asphalt, not concrete pans, sidewalks, or gutters.
7. Flat top manholes are not an approved alternative. A variance is needed for special instances.
8. New holes for pipeline connections to existing manholes must be cored, not broken open with sledge hammers.

301.15 CONSTRUCTION OF STORM WATER INLETS AND STRUCTURES

1. All concrete and steel reinforcing work shall be in accordance with the Colorado Department of Transportation Sections 601 and 602, except as modified by Section 217 of these standard specifications. Additives for concrete, other than those specified in the mix design, shall not be used without prior approval of the engineer. When approved for use, chemical admixtures or additives shall comply with applicable ASTM or AASHTO standards. Calcium chloride or admixtures containing chloride shall not be allowed in reinforced concrete.
2. All casting used shall sit flush with the surrounding concrete.
3. The bottom of all inlet structures shall be formed to drain to the outlet pipe as per the inlet details.
4. All inlet structures shall be flushed with water after completion of construction. The inlets are not acceptable if water remains in the invert of the structure.
5. The minimum size of the outlet pipe from the inlet structure shall be eighteen (18) inches in diameter. The outlet pipe shall be laid to provide a minimum velocity in the pipe of three (3) feet per second.
6. Access covers will be located above the pipelines so the City's jetting equipment can access the pipelines.
7. Inlets and headwalls must be cast in place, no precast inlets or headwalls are acceptable.
8. New holes for pipeline connections to existing inlets must be cored, not broken open with sledge hammers.

301.16 TESTING AND FLUSHING PIPE

1. Prior to final acceptance of each section of the storm sewer line, the storm drains shall be cleaned by appropriate methods approved by the engineer. All dirt and debris shall be prevented from entering the existing storm drain system by means of watertight plugs or other suitable methods. The engineer may require the storm sewer line be air pressure tested prior to final acceptance. When an air tested air pressure test is required the contractor shall adhere to the test procedure called out by the engineer. A water test for manholes may also be required by the engineer. This test will be subject to less than a 1"/hour rise or fall to pass.
2. Any visible infiltration which the engineer considers to be detrimental to the system shall be repaired in a manner approved by the engineer before the work will be accepted. No manhole will be accepted that has any visible infiltration.
3. Upon completion of the construction, the engineer will carefully inspect all storm drains and appurtenances. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the storm drain and manholes shall be left smooth, clean, and free from obstructions throughout the entire length. Manhole rings and covers must be raised to finished grade before acceptance of the storm drain.
4. The storm sewer pipelines may be inspected by camera instead of air tested if approved by the engineer.

301.17 VIDEO OF COMPLETED STORM SEWER PIPE

1. The completed storm sewer line shall be recorded by a camera by the contractor prior to final acceptance. The recording shall be submitted to the engineer for review.