

Town of Mead Design Standards and Construction Specifications

SECTION 33 40 00 STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping and concrete structures for storm sewer system, roof drainage, and culverts
- B. Riprap for channel lining, outlet protection and rock check dams

1.2 REFERENCES

- A. ACPA - American Concrete Pipe Association
- B. ASTM – American Society for Testing and Materials
 - 1. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 2. ASTM C150 - Portland Cement
 - 3. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
 - 4. ASTM C478 – Precast Concrete Structures
 - 5. ASTM C497 - Testing Concrete Pipe, Manhole Sections, or Tile
 - 6. ASTM A48 - Gray Iron Castings
 - 7. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 8. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 9. ASTM C33 - Concrete Aggregates
 - 10. ASTM C478 - Precast Reinforced Concrete Manhole Sections
- C. Urban Storm Drainage Criteria Manual, Mile High Flood District (MHFD)
- D. Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction

1.3 SUBMITTALS

- A. Shop Drawings: Provide drawings with pipe and structure details, design standards, reinforcement, dimensions, etc. Provide additional detailed information (including elevations, fittings, specialty materials or fabrications, etc.) for special or custom features, structures, junctions and/or pipes. Provide pipe-laying schedule.
- B. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications.
- C. Manufacturers Certificate: Certify that pipe, meets or exceeds specified requirements. Confirm all materials comply with applicable standards.
- D. Test Reports: Submit all shop and field test reports in accordance with the Town of Mead Design Standards and Specifications.
- E. Provide sufficient data to verify compliance with these specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery
 - 1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun.
- B. Storage

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1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: (direct sunlight, mud. etc).
 2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months.
 3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging.
 - a. Do not stack pipe higher than five (5) feet.
- C. Handling
1. Handle to ensure installation in sound undamaged condition.
 2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection.
 3. Use hooks or straps with broad, well padded contact surfaces for lifting sections of pipe.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Weather limitations: Do not install piping over frozen surfaces or in standing water.

PART 2 GENERAL PRODUCTS

2.1 PIPE MATERIALS

- A. General: Provide pipes of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated
- B. Fittings: Furnish bends, ells, tees, wyes, couplings and other fittings of the same type and class of material having equal or superior physical and chemical properties as acceptable to the Engineer
- C. Reinforced Concrete Pipe: ASTM C76,
1. 12-inch RCP Class V, with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 2. 15-inch RCP Class IV (Class V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 3. 18-inch thru 24-inch RCP Class III (Class IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
 4. 24-inch thru 36-inch RCP Class II (Class III, IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
- D. PVC Sewer Pipe: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.
- E. HDPE Sewer Pipe: smooth interior, corrugated exterior piping conforming to ASTM D 2412, ASTM D 3212, AASHTO specifications M252 and M 294, joints to conform to ASTM F 477.
- F. Corrugated Metal Pipe (CMP): AASHTO M218 or ASTM A444, helically or circumferentially corrugated, mill galvanized steel.
1. Furnish galvanized sheet metal, 16 gauge, 0.064-inch galvanized thickness, 0.0598-inch base metal thickness and size of conduit as indicated. Sizes indicated are minimal inside diameters.
 2. Furnish width and lap depths and corrugations conforming to AASHTO M36.
- G. Corrugated Aluminum Pipe (CAP): ASTM M197 helically or circumferentially corrugated.
1. Aluminum alloy, 16 gauge, size shown on approved drawings.

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2. Furnish width and lap depths and corrugations conforming to AASHTO M196.
- H. Perforated PVC Sewer Pipe for Underdrains: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.

2.2 MATERIALS

- A. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Engineer for pipe stubouts.
- B. Cleanouts: Provide as indicated, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the word "STORM".
- C. Reinforcement
 1. Reinforcing Steel: ASTM A615 Grade 60
 2. Welded Wire Fabric: ASTM A185
- D. Concrete: Refer to Section 31 13 00 - Rigid Paving and Flatwork Specifications
 1. Minimum compressive strength: 5000 psi at 28 days
 2. Cement: ASTM C150, Portland Cement, Type II
 3. Aggregates: ASTM C33, free of deleterious substances
- E. Gaskets: ASTM C923
 1. Mastic: FS SS-S-210A, "RAM-NEK" or accepted substitution
 2. Rubber: Neoprene, 40+ 5 hardness when measured by ASTM D2240, Type A durometer
- F. Inlet Gratings and Manhole Rings and Covers
 1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces.
 2. Provide bike/pedestrian-safe grates where such traffic is anticipated.
 3. Set grate on frame such that openings maximize inlet intake.
 4. Covers to seat at all points on ring.
 5. Covers to be cast with "STORM SEWER" in 1 1/2" tall flush letters minimum in addition to the symbol of a fish with the phrase "DUMP NO WASTE, DRAINS TO WATERWAYS".
 6. Manhole covers to receive asphalt varnish coating hot dip applied at foundry, 6 mils thick.
- G. Manhole Height Adjustment: Use precast concrete grade rings.
- H. Rock Subbase: 1-1/2 -inch minus, well-graded gravel over compacted subgrade
- I. Water: Clean and free of deleterious substances
- J. Grout:
 1. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days
 2. Epoxy Grout: Three Component Epoxy Resin System
 - a. Two liquid epoxy components
 - b. One inert aggregate filtered component
 - c. Each component furnished in separate package for mixing at job site

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2.3 CONCRETE CATCH BASINS AND MANHOLES

A. General:

Comply with Town of Mead Standard Details and CDOT standards and specifications for public storm sewer products.

B. Precast Concrete Units for Catch Basins and Manholes:

1. Manufacturers: Carder Concrete Products, Amcor Precast, or accepted equal
2. Specification: ASTM C478 and C789, wall "B"
 - a. Minimum wall thickness: greater of six (6) inches or 1/12 of internal diameter
 - b. Reinforced
 - c. Grade rings as required
 - d. Cast steps into units.

C. Precast Units or Cast-in-place as shown. Use concrete that will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan or sawcut in field.

D. Cast-in-place Concrete Units: As shown on the approved drawings or standard detail drawings and complying with the Colorado Department of Transportation drainage and design standards.

E. Manhole Steps: Steel bar, 1/2-inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF" or equal

2.4 PVC PLASTIC INLINE DRAINS AND DRAIN BASINS

A. Manufacturer: Nyloplast America Inc. or accepted substitution.

B. Inline drains and drain basins shall be manufactured from PVC pipe stock, utilizing a thermo molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212.

C. Surface drainage products shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.

D. Inline drain and drain basin adapters and accessories:

1. Adaptable to SDR-35 PVC piping.
2. Watertight adapters.

E. Cast iron or ductile iron frames and grates:

1. Light –traffic rated
2. Pedestrian rated
3. Hinged and locking
4. Made specifically for use with the specified inline drains and drain basins
5. Painted black
6. ASTM A-48-83 Class 30B or A536 grade 70-50-05 grade iron
7. Size indicated on the approved drawings

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2.5 CONCRETE FABRICATION

A. Vault/Manhole Sections

1. Precast concrete dimensions as shown on plans
2. Minimum manhole inside diameter: 48 inches
3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H20 loading
4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly
6. Access opening: Minimum 24 inches clear or as indicated
7. Pipe connection: As indicated on Drawings
8. Pipe knockout: As indicated on Drawings
9. Precast concrete, monolithic base or cast-in-place base
10. Manhole steps: 12 inches on center, vertical alignment above largest bench or open area

B. Grating and Metal Frame: As specified on approved drawings

2.6 SOIL MATERIALS

A. Furnish pipe bedding and cover as specified in Section 31 00 00 – Earthwork.

B. Riprap Materials:

1. Hard, dense, durable stone, angular in shape and resistant to weathering
2. Minimum specific gravity of 2.5
3. Material may be approved by Town Engineer, if by visual inspection, the rock is determined to be sound and durable.
4. Town Engineer may require Contractor to furnish laboratory test results if the material appears to be marginal or unacceptable.
5. Tested material shall meet the following requirements for abrasion resistance or compressive strength:

Test	Test Method	Requirement
Abrasion Resistance by Los Angeles Machine	ASTM C 535	50% loss, max
Unconfined Compressive Strength of Drilled Core Specimen	AASHTO T 24	2500, min

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6. Gradation:

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	Mean Particle Size, d_{50} (Inches)
Type L	70-100	15	9
	50-70	12	
	35-50	9	
	2-10	3	
Type M	70-100	21	12
	50-70	18	
	35-50	12	
	2-10	4	
Type H	70-100	30	18
	50-70	24	
	35-50	18	
	2-10	6	

7. Granular Riprap Bedding:

a. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4"	90-100
1/2"	25-60
3/8"	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

C. Pipe Bedding:

- a. Refer to Section 31 00 00 – Earthwork
- b. Minimum 6 inch deep, unless specified otherwise

D. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

PART 3 EXECUTION

3.1 PIPE PREPARATION

- A. Shape trench and place bedding as specified in Section 31 00 00 and as shown on the approved drawings.
 1. Dig bell or coupling holes.
 2. Do not support pipe on blocks or mounds of earth.

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3. Provide uniform and continuous bearing and support for full length of pipe between bell holes.
 4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle.
- B. Alignment and Grade
1. Except as indicated on the Drawings, lay all pipe straight and at a uniform grade.
 2. Use batter boards to determine and check pipe subgrades.
 3. Other methods of maintaining alignment and grade may be acceptable if approved by the Town Engineer.

3.2 PIPE INSTALLATION

- A. Inspect pipe and accessories for defects before lowering into trench.
- B. Replace any defective, damaged or unsound pipe.
- C. Carefully lower pipe, fittings, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage. Do not dump or drop pipe or accessories into trench.
- D. Pipe embedment shall be as specified in Section 31 00 00 – Earthwork for pipe.
- E. Protect from lateral displacement by placing the specified pipe embedment material.
- F. Do not lay pipe in water, under unsuitable weather conditions or under unsuitable trench conditions.
- G. Joint to form true and smooth line.
- H. Remove any pipe not making a good fit.
- I. Begin pipe laying at the lowest point unless reverse laying is accepted by Engineer.
- J. Utilize implements, tools and facilities as recommended by the manufacturer and/or catch basins if required to remove debris.
- K. Keep pipe clean during and after laying.
- L. During construction, close all open ends with watertight expandable type plugs.
 1. At the end of each day's operations.
 2. Whenever pipe ends are left unattended.
 3. Deposit adequate backfill on pipe to prevent flotation.
 4. Do not use wood, burlap or other similar temporary plugs.
- M. Remove and re-lay any pipe which has floated.

3.3 PRECAST STRUCTURE PREPARATION

- A. Verify items provided by other section of Work are properly sized and located.
- B. Verify that built-in items are in proper location, ready for roughing into Work.
- C. Verify excavation for manholes is correct.
- D. Excavation and Backfill: Refer to Section 31 00 00 - Earthwork for requirements.
- E. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- F. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction.

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3.4 CATCH BASINS

- A. Construct catch basins to the sizes and shapes indicated, and to conform to requirements of authorities having jurisdiction.
 - 1. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction.
 - 2. For precast units, set in place to accurate elevations on firm, solid bed, plumb and level.
 - 3. Pipe openings, elevations and alignment per plans
 - 4. Seal and grout all pipe penetrations
 - 5. Set cast iron frames and gratings to the elevations indicated.

3.5 PLACING MANHOLE SECTION OR CAST-IN PLACE BASE

- A. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock to a 6-inch minimum depth, and vibrate for compaction.
- B. Place base pad, trowel top surface level to accept manhole section with uniform bearing all around.
- C. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base or place first manhole section directly in wet concrete.
- D. Place manhole sections plumb and level, trim to correct elevations.
- E. Clean ends of sections and place double mastic gasket.
- F. Fill inside and outside of joint completely with non-shrink grout and trowel smooth.
- G. Cure non-shrink grout using approved methods.
- H. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Town Engineer.
- I. Completed manholes shall be rigid and watertight.
- J. Coordinate with other sections of work to provide correct size, shape, and location.

3.6 PREFORMED GASKETS

- A. Remove and replace manhole sections which have chipped or cracked joints.
- B. Thoroughly clean section joints.
- C. Install gasket in conformance with manufacturer's recommendations.
- D. Only use primer furnished by gasket manufacturer.

3.7 MANHOLE INVERT

- A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench ½ inch per foot for drainage to invert.
- B. Invert shape to conform to radius of pipe it connects.
- C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert.
- D. Construct in conformance with standard drawings.

3.8 MANHOLE RINGS AND COVERS

- A. Place rings in bed of non-shrink grout on top of manholes.
- B. Ensure no infiltration will enter manhole at this location.
- C. Carry non-shrink grout over flange of ring.

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- D. Set top of ring flush with all surfaces subject to foot and vehicular traffic.
- E. Set top of ring 6 inches above surfaces in open, unraveled, non-pedestrian areas.
- F. Use precast grade rings for height adjustment.

3.9 CONNECTION TO EXISTING MANHOLES

- A. Maintain flow at all times.
- B. Prior approval of proposed method for maintaining flow must be obtained from Engineer.
- C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure.
- D. Make connection during low flow periods.

3.10 GROUT

A. PREPARATION

- 1. Non-Shrink, Non-Metallic Grout, General Use
 - a. Clean concrete surface to receive grout.
 - b. Saturate concrete with water for 24 hours prior to grouting and remove excess water just prior to placing grout.
 - c. Cold weather conditions
 - i. Warm concrete, substrate and base plate to 40 degrees F, or above; store grout in warm area.
 - ii. Follow manufacturer's recommendations for cold weather application.
 - d. Hot weather conditions
 - i. Use cold mixing water and cool base plate if possible; store grout in cool area.
 - ii. Follow manufacturer's recommendations for hot weather application.
 - e. Apply to clean, sound surface.
 - f. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer.
- 2. Epoxy Grout: Apply only to clean, dry, sound surface.
 - a. Patch cavities in concrete including, but not limited to, tie holes, and structural and equipment support.

B. APPLICATION

- 1. Non-Shrink, Non-Metallic Grout
 - a. Mix in a mechanical mixer
 - b. Use no more water than necessary to produce flowable grout.
 - c. Provide air vents where necessary to eliminate air pockets.
 - d. Place in accordance with manufacturer's instructions.
 - e. Where exposed to view finish grout edges smooth.
 - f. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound.
 - g. Wet cure grout for 7 days, minimum.
 - h. Maintain the temperature at a minimum of 40 degrees F until grout reaches 3000 psi.
 - i. After placement of grout, eliminate excessive external vibration.

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2. Epoxy Grout
 - a. Mix and place in accordance with manufacturer's instructions.
 - b. Completely fill all cavities and spaces around dowels and anchors without voids.
 - c. Obtain manufacturer's technical assistance as required to insure proper placement.
- 3.11 RIPRAP**
- A. Do not place riprap over frozen or spongy subgrade surfaces.
 - B. Place riprap at pipe outlets and in channels as indicated on plans. Top of riprap to match invert of outlet pie and channels.
 - C. Excavate and prepare subgrade.
 - D. Place geotextile fabric per plans under all bedding. Place bedding and place riprap on bedding per plans.
 - E. Material may be machine placed and then arranged as necessary by use of a Gradall with multi-prong grapple device or by hand to minimize voids. Dumping alone is not sufficient to achieve properly placed riprap.
- 3.12 FIELD QUALITY CONTROL**
- A. Field inspection and testing including a lamp test will be performed for every section of pipe after backfill has occurred.
 1. Contractor shall furnish suitable assistance to the Town Engineer.
 2. A minimum of 75% of a true circle will be required to indicate a properly constructed line.
 3. Contractor will repair any section not passing the lamp test.
 - B. Request inspection immediately after placing cover over pipe.
 - C. Backfilling and testing as required per Section 31 00 00 - Earthwork.

END OF SECTION 33 40 00