

Section 402. STORM SEWERS

402.01 Description. This work consists of constructing storm sewers of the size and class specified and shall include excavation and backfilling. Storm sewers are divided into five classes as shown in Table 402-1.

When only the size and class of sewer is specified, the Contractor may furnish any of the alternates permitted in Table 402-1.

When a particular type of sewer material is required in lieu of the classes designated in Table 402-1, the type and size of the sewer will be specified in the contract documents.

A higher strength or greater thickness of sewer may be substituted for the minimum strength or minimum thickness of sewer specified.

Table 402-1 Pipe Alternates for Storm Sewer Classes

Type of Pipe Depth of Cover in feet (a)	Class A Sewer 0 to 10	Class B Sewer >10 to 16	Class C Sewer >16 to 23	Class D Sewer >23 to 33	Class E Sewer 0 to 3 (b)
Reinforced Concrete Pipe (c)	II	III	IV	V	IV
Nonreinforced Concrete Pipe (d)	1	3	No	No	No
Corrugated and Spiral Ribbed Al-Alloy Pipe (e)	Yes	Yes	Yes	Yes	No
Corrugated and Spiral Ribbed Steel Pipe (f)	Yes	Yes	Yes	Yes	No
Smooth-Lined Corrugated Plastic Pipe (CPE) (g) (h) (i)	Yes	No	No	No	No
Corrugated Polyvinyl Chloride Pipe (CPV) (h) (j)	Yes	No	No	No	No

- a. Cover, including the pavement structure is defined as the height of fill above the top of the pipe.
- b. Class E Sewer applies when the sewer is beneath the influence of proposed pavement and the depth of cover is 3 feet or less.
- c. Roman numerals refer to class of reinforced concrete pipe, AASHTO M 170.
- d. Arabic numerals in Table 402-1 refer to the class of nonreinforced concrete pipe, AASHTO M 86.
- e. Permitted for 12 to 66-inch spiral ribbed and 12 to 18-inch helically corrugated 2 2/3 x 1/2-inch aluminum alloy pipe only.
- f. Permitted for 12 to 84-inch spiral ribbed and 12 to 18-inch helically corrugated 2 2/3 x 1/2-inch steel pipe only.
- g. CPE shall conform to AASHTO M 294, Type S Polyethylene pipe.
- h. Permitted only for 24-inch diameter pipe and under. Minimum cover 3 feet (measured from top of pipe to final grade).
- i. 30-inch and 36-inch pipe are approved for selected state projects only and installed according to the special provisions.
- j. CPV shall conform to AASHTO M 304.

402.02 Materials. Materials shall meet the following requirements.

Concrete, Grade S3	701
Mortar, Type R-2	702
Granular Material Class II, III, IIIA	902
Aggregate 6A	902
Sewer Pipe	909
Sealers for Sewer Joints	909
Steel Pipe (for Jacking-in-Place)	909
Geosynthetics	910

402.03 Construction.

- A. **Excavation, Trench Construction, and Sewer Bedding.** Construction methods shall be according to the health and safety requirements in subsection 104.10. Begin the trench excavation at the downstream end of the sewer. The trench shall be excavated to the lines and grades shown on the plans or as established by the Engineer. The trench width shall be sufficient to provide free working space and to provide for proper compaction of the backfill around the pipe and shall be at least the minimum width detailed on the standard plan.

The bottom of the trench shall be shaped so that the pipe will be uniformly supported. Where rock or hardpan is encountered, excavate the trench to a minimum of 6 inches below the proposed bottom of the pipe and backfill and compact with granular material Class II.

Where unstable soil conditions, or obstructions other than rock, require excavation of the sewer trench below the elevation detailed on the plans; excavate, backfill, and compact the trench as directed by the Engineer. Backfill material for trench undercutting due to unstable soil conditions shall be coarse aggregate 6A. This work will be paid for as trench undercut and backfill.

Surplus excavated material from sewer trenches becomes the property of the Contractor and shall be disposed of according to subsection 205.03.P.

Residential connections, water mains, gas mains, conduits, and drains, when encountered in the sewer trench, shall be supported and protected across the excavation.

- B. **Repair of Damaged Coated Surfaces.** Metallic coated pipe surfaces damaged in transporting, handling, or installing the pipe shall be repaired according to subsection 716.03.E at no cost to the Department.
- C. **Laying and Jointing Pipe.** All storm sewers shall be laid true to the lines and grades given, bells or grooves upgrade, ends fully and closely jointed, and each section shall have a full, firm bearing throughout its length.

All pipe section/joint assemblies for use in sewers shall be selected from the Qualified Products List. A field assembly diagram shall be provided to the Engineer. Pipes with

diameters greater than 24 inches shall have the pipe joints wrapped with a geotextile blanket. The fabric shall have a minimum width of 3 feet and shall be centered on the joint.

The joints for smooth lined corrugated plastic pipe (CPE and CPV) shall be provided with homing marks to indicate correct joining of the pipe and joint material during field installation.

The Engineer will select at least 50 percent of the installed length of each size of corrugated plastic pipe (CPE and CPV) to be tested by the Contractor for deformation using a nine point mandrel. The mandrel shall have an effective diameter equal to 95 percent of the nominal pipe diameter. The Contractor shall provide the Engineer with a proving-ring to verify mandrel size. The Contractor shall perform the mandrel testing after the required compaction of the trench backfill has been achieved. Conduct the mandrel testing between 5 and 10 working days prior to pavement surfacing or completion of final grade, except as otherwise approved by the Engineer. Pipe with diameter reduced by 5 percent or more shall be removed and either re-installed, if the pipe is not damaged, or replaced at no cost to the Department. Such pipe shall not be re-installed without prior approval from the Engineer. The Contractor will be responsible for all expenses and delays due to the replacement of deformed or damaged pipe. Pipe damaged by the Contractor's operations shall be removed, replaced and mandrel tested at the Contractor's expense.

Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes on top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with concrete plugs and waterproofed.

Sewer sections showing signs of settlement or poor alignment as determined by the Engineer, shall be taken up and relaid at the Contractor's expense.

Reinforced concrete elliptical pipe shall be installed with the longer axis placed horizontally unless otherwise specified.

Type HE elliptical pipe shall be installed with the longer axis placed within ± 5 degrees of horizontal.

Type VE elliptical pipe shall be installed with the longer axis placed within ± 5 degrees of vertical.

Existing live sewers and service leads shall be maintained and carefully protected during the construction of the sewers. Damaged sewer or service leads shall be immediately repaired or replaced as directed by the Engineer. Service interruptions shall be kept to a minimum and may require coordination with the local municipality or utility company.

- D. **Sewer Taps.** Connections to storm sewers owned by counties, municipalities, or drain commissions shall be according to the regulations of the owner and the contract documents. If a conflict exists between the owner's regulations and these specifications, the owner's requirements will take precedence.

Connections to existing storm sewers having a plug or bulkhead shall be made with a watertight joint. The plug or bulkhead shall be removed without damage to the sewer, and the material removed shall be disposed of as specified under subsection 204.03.B.

When tapping an existing pipe, a minimum opening equal to the outside diameter of the inlet pipe plus 6 inches shall be cut into the receiving pipe. A minimum 3-inch mortar layer shall be packed completely around the inlet pipe and struck smooth with the inner wall of the receiving pipe. Pipe passing through a pipe wall shall be cut flush to conform to the inner wall. The inlet pipe on the outside portion of the connection shall be encased to provide sufficient bearing under the pipe. An existing pipe damaged by the Contractor during the tapping operation shall be repaired or replaced at the Contractor's expense. Direct tapping of sewers is restricted to inlet pipes with outside diameters less than one half the inside diameter of the trunk sewer. All other taps will require construction of a manhole structure according to section 403. Other methods for tapping existing sewers shall be approved by the Engineer prior to use.

- E. **Sewer Bulkheads.** Construct sewer bulkheads with Grade S3 concrete or with brick or block masonry. Extend the bulkhead a minimum of one foot into the pipe from the inner wall of the drainage structure. Masonry bulkheads shall be constructed according to subsection 403.03.
- F. **Backfilling.** Backfill according to subsection 401.03.F.
- G. **Corrugated Steel Sewer.** Dissimilar types of base metal (steel or aluminum alloy) or dissimilar types of coatings on steel (zinc or aluminum) shall not be used in a single line of pipe.
- H. **Sewer Jacked-in-Place.** This work shall be done as specified under subsection 401.03.I.
- I. **Disposal of Surplus Material.** Disposal of surplus material shall be as specified under subsection 205.03.P.
- J. **Cleanout.** Storm sewers installed on the project shall be maintained and shall be free of silt, debris, and other foreign matter at the time of final acceptance.
- K. **Videotaping Sewer.** Storm sewers shall be inspected by closed circuit television. This work shall include dewatering or diverting flow in sewers to the degree necessary for the television inspection. The inspection shall include a written log of any damage or installation defect identified in the video. Video inspection is not required for extension of existing catch basin leads less than 20 feet and sewers 36 inches in diameter or greater.

For sewers under pavement, the inspection shall be conducted after the required compaction of the trench backfill has been achieved, and between 5 and 10 working days prior to pavement surfacing or completion of final grade, except as otherwise approved by the Engineer.

For sewers not under pavement, the inspection shall be conducted as close to project completion as possible, while allowing sufficient time for corrective action determined necessary from the video inspection and as directed by the Engineer.

After completion of the video inspection, the Contractor shall furnish two copies of the videotape to the Engineer. All tapes shall be labeled to describe the reaches of sewer contained in the tapes, including street location and manhole numbers. Where manhole numbers are not provided, the Contractor shall devise and assign a numbering system which allows for identification in the inspection report and video. The Contractor shall also provide two copies of a log indicating any damage or installation defect such as pipe deformation, cracking, joint separation, corrosion, perforation or other discernible features observed in the video. The damage or defect must be located by meter marking of the tape on the inspection log.

1. **Sewer Flow Control.** Flow control shall be used whenever required to bring the depth of flow within the range specified below for video inspection. The Contractor shall furnish to the Engineer the proposed method of sewer flow control for approval, prior to starting work.
 - a. **Depth of Flow.** The depth of flow in the sewer during the videotaping operations shall not exceed 2 inches. When sewer line depth of flow at the upstream manhole of the section being inspected is above 2 inches, the flow shall be reduced by plugging or blocking of the flow, or pumping and bypassing of the flow, as specified.
 - b. **Plugging or Blocking.** A sewer line plug shall be inserted into the line upstream of the section being inspected. The plug shall be designed so that all or any portion of the flow can be released. During video inspection, flow depth shall be reduced to 2 inches. After the work has been completed, flow shall be restored to normal. Flow discharge shall be metered to prevent erosion.
 - c. **Pumping and Bypassing.** When pumping and bypassing is required, the Contractor shall supply the pumps, conduits, and other equipment to divert the flow around the sewer section in which the inspection is to be performed. The bypass system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during a rainstorm. The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system.
 - d. **Flow Control Precautions.** When flow in a sewer line is plugged, blocked, or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging.

Further, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

2. **Video Inspection.** The Contractor shall furnish all materials, labor, and equipment necessary for performing a video inspection of sewers.

- a. **Equipment.** The camera used for the inspection shall be specifically designed and constructed for this purpose and shall be equipped with a pan and tilt camera head external to the main body of the camera to allow inspection of the sewer joints and cracks or defects identified in the inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire perimeter of the pipe. The camera shall be operative under water. The camera and other components of the video system shall be capable of producing picture quality to the satisfaction of the Engineer, and if unsatisfactory, the pipes shall be reinspected to obtain satisfactory results with no additional payment.

The camera must use continuous running tape on which audio and video information can be recorded. Recordings must include the date and camera location. Date information must include the month, day, and year. The tape must contain a continuous record of the sewer section, from manhole to manhole or from end to end. The recording shall be made in color, on high quality VHS format tape, at a standard play speed. Other recording media may be used if approved by the Engineer.

- b. **Procedure.** The camera shall be moved through the line in either direction at a rate not to exceed 0.5 feet per second, stopping when necessary to permit documentation of the culvert or sewer condition. Manual winches, power winches, cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. When manually operated winches are used to pull the camera through the line, suitable equipment shall be used to insure good communications among crew members.

The camera shall be adjusted to a height such that it is above the level of the flow. If the camera encounters a dip in the sewer such that water is standing above the springline of the sewer pipe, or if the camera lens becomes submerged, the camera shall be withdrawn from the sewer and inserted from the other end as far as possible. Backing the camera into a reach is not allowed.

Measurement to location of defects shall be above ground by means of a meter device. Marking defect locations on the cable, etc., is not sufficient. Accuracy of the distance meter must be within one foot and shall be checked using a walking meter, roll-a-tape, or other suitable device.

3. **Traffic Control.** Traffic control to perform the video inspection shall be approved by the Engineer at least five days prior to beginning work. The traffic control plan shall be according to the *Michigan Manual of Uniform Traffic Control Devices*.

All traffic lanes shall remain open unless otherwise approved by the Engineer. If a lane or shoulder closure is necessary, traffic control measures shall be according to the traffic control plan.

402.04 Measurement and Payment.

Contract Item (Pay Item)	Pay Unit
Sewer, CI __ , __ inch, Trench Det __	Foot
Sewer, Reinf Conc Ellip, CI __ , (rise) by (span) inch, Trench Det __	Foot
Sewer, CI __ , (Type), __ inch, Jacked-in-Place	Foot
Sewer Tap, __ inch	Each
Sewer Bulkhead, __ inch	Each
Trench Undercut and Backfill	Cubic Yard
Dewatering System, Trench	Foot
Videotaping Sewer and Culv Pipe, __ inch	Foot

- A. **Sewer and Sewer, Reinf Conc Ellip** of the size, class and trench detail specified, will be measured in place, by length in feet, from center to center of end manholes, catch basins or inlets, with no deductions in length for intermediate structures. Payment includes excavation and backfill. Mandrel testing where required is also included.
- B. **Sewer, Jacked-in-Place**, of the size and class specified, will be measured by length in feet, determined by multiplying the number of units actually jacked by their commercial laying length.
- C. **Sewer Tap**, of the size specified is measured and paid for each tap into an existing system. If a drainage structure or manhole is required, the drainage structure will be of the size and type as called for on the plans. When tapping an existing sewer line using a drainage structure, one sewer tap will be paid for in addition to the drainage structure.
- D. **Sewer Bulkhead**, of the size specified, will be measured as units. Only bulkheads for storm sewers larger than 12 inches in diameter will be measured for payment. Sewer bulkheads for pipes less than 12 inches in diameter or constructed as part of abandoning or removing drainage structures for pipes shown on the plans will not be paid for separately, but are included in the related item of work. Pipes greater than 12 inches encountered but not shown on the plans will be bulkheaded and paid for separately.
- E. **Trench Undercut and Backfill** will be measured by volume in cubic yards computed from the length, depth, and width of undercut authorized by the Engineer. The width of the trench authorized will be as shown on the plans for the size of pipe required. No allowance will be made for sloping the sides of the trench. **Trench Undercut and Backfill** includes excavation and disposal of material and furnishing, placing, and compacting the backfill up to the bottom of trench elevation shown on the plans.
- F. When rock excavation is required, it will be paid for separately according to subsection 205.04.
- G. **Dewatering System, Trench** will be measured in linear feet of sewer required to be dewatered. Where an item for **Dewatering System, Trench** is not included in the contract documents and the Contractor uses a dewatering system, it will not be paid for separately but will be considered as having been included in the contract unit prices bid for related items of work.

- H. Tunneling in place of open-cut construction methods may be authorized by the Engineer. Quantities of pay items required for corresponding open-cut construction will be deleted from the contract or reduced proportionately. No adjustment will be made in the pay items of Minor Traffic Devices or Flag Control. If there is no contract unit price for tunneling of the size pipe proposed, payment will be made as Extra Work at a price agreed upon before starting the work. In no case will payment for the work performed by tunneling methods exceed the amount which would have been paid using the open-cut method.

- I. **Videotaping Sewer and Culvert Pipe** shall be measured by length in feet and shall include dewatering, flow control, video inspection, and all documentation. Traffic maintenance and control will be paid for separately according to subsection 812.04.