



Designation: C1821/C1821M – 16 (Reapproved 2021)^{ε1}

Standard Practice for Installation of Underground Circular Precast Concrete Manhole Structures¹

This standard is issued under the fixed designation C1821/C1821M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

^{ε1} NOTE—Reapproved with editorial changes to referenced documents in January 2021.

1. Scope

1.1 This practice covers the procedures to be followed in the planning, site preparation, installation, testing and backfilling of underground vertical reinforced circular precast concrete manholes and components manufactured in accordance with Specification C478/C478M and used in sewer, drainage, and water works.

1.2 Concrete pipe and box culverts are not covered under this practice. Also, precast concrete utility structures covered in Specification C858 are excluded from this practice.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

¹ This test method is under the jurisdiction of ASTM Committee C13 on Concrete Pipe and is the direct responsibility of Subcommittee C13.06 on Manholes and Specials.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- C443 Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- C443M Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
- C478/C478M Specification for Circular Precast Reinforced Concrete Manhole Sections
- C822 Terminology Relating to Concrete Pipe and Related Products
- C858 Specification for Underground Precast Concrete Utility Structures
- C881/C881M Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- C923/C923M Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- C928/C928M Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- C969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- C969M Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
- C990 Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- C990M Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
- C1107/C1107M Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- C1244/C1244M Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
- C1478/C1478M Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals
- D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2488 Practice for Description and Identification of Soils (Visual-Manual Procedures)

F2510/F2510M Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes

2.2 *AASHTO Standard:*

AASHTO M145 Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes³

2.3 *Federal Standard:*

29 CFR Part 1926 Safety and Health Regulations for Construction⁴

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete manholes, see Terminology **C822**. For terminology related to soil classifications, see Practices **D2487** and **D2488**.

3.2 *engineer, n*—owner’s representative, either designer of record or inspector, with responsible charge of the owner’s interest during the installation phase of construction.

3.3 *installer, n*—prime contractor, subcontractor, or work crew assigned the responsibility to excavate, place, and backfill the furnished manhole structure.

3.4 *non-shrink grout, n*—a cementitious in accordance with Specification **C1107/C1107M**, or Specification **C928/C928M**, or polymer modified in accordance with Specification **C881/C881M**.

4. Significance and Use

4.1 This practice is useful as a reference by an owner and/or the engineer in preparing project specifications.

4.2 The practice is useful as a reference by an owner, engineer, or installing contractor to properly install precast concrete circular manholes.

5. Site Inspection

5.1 The construction area shall be carefully inspected by the installer using the project drawings and a checklist to identify the work to be done and to determine that the plans are correct.

5.1.1 The location of the circular manhole structure should be where it will cause minimal interference with traffic and shall be clearly defined on project documents.

5.1.2 All underground facilities and structures that are in possible conflict with the installation shall be located and identified. Location markings shall be placed by the affected utilities before the construction.

5.2 The jobsite inspection shall identify any obstacles that will interfere with manhole excavation, unloading or setting operations, product storage, work progress, or create a safety hazard. Precautionary arrangements shall be made before excavation begins.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

⁴ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

5.3 The jobsite inspection shall give consideration to the soil structure and ground water table so that proper shoring or sloping or both may be planned in advance of the excavation work that will affect the installation of the manhole structure.

6. Planning

6.1 Permits required to do work in accordance with the detail plans and project construction schedule shall be secured before commencement of the manhole installation.

6.2 All utilities and owners of surface and subsurface facilities and structures in the area shall be given advance notification of proposed excavation directly by the installer or at a designated pre-construction meeting.

6.3 Planning shall include the coordination of all responsible parties, including the designated precast concrete manhole manufacturer to arrange for the delivery, distribution, and storage of required material. If such material cannot be stored on the site, other storage areas or delivery arrangements shall be provided.

6.4 Prior to ordering of the manhole components the installer shall review all proposed manhole installation locations on the project with the design engineer and identify any potential conflicts or reasons for movement of the manhole to a more appropriate location. If a conflict is identified onsite prior to excavation or while performing layout, the engineer shall be notified immediately to propose alternative location and to provide the precast manhole producer opportunity to alter production of the manhole structure.

6.5 The installer shall notify the precast concrete manufacturer if any delays in permits, utility location, or other unforeseen conditions will alter the original agreed delivery schedule or revise a precast manhole structure configuration as shown in the project plans or approved fabrication drawings.

6.6 As required by the owner, engineer, installer or manhole manufacturer shop drawings shall be prepared for approval prior to fabrication. The shop drawings shall include, but not limited to detailed information describing each structure component to be fabricated and the associated assembly of the manhole structures by the installing contractor.

6.6.1 Shop drawings shall also include steel layout details of any specialty items including flattop slabs, flattop reducing slabs, base sections, special barrel section openings, reducer cones.

6.6.2 The shop drawings shall include certification of compliance to the project plans and specifications or clearly note any specific exceptions to the same.

7. Delivery

7.1 Manufacturer shall verify manhole components are in compliance to approved shop drawings prior to shipment to the project site.

7.2 The installer shall inspect the manhole components for damage during shipping and unloading, and any non-compliance to approved shop drawings.

7.2.1 If any damage or non-compliance is identified, the installer shall take corrective action by notifying the manufacturer. Upon inspection if the damage may affect the performance of the manhole structure, the area shall be repaired in accordance with Specification **C478/C478M**. If the damaged manhole component cannot be repaired in accordance with Specification **C478/C478M**, that component shall not be installed.

7.2.2 The installer shall measure the received manhole components upon delivery to verify the products furnished are in compliance to the approved shop drawings. This includes but not limited to: pipe hole placement to confirm pipe entrance and exit angles are correct, the distance from the exterior bottom of the manhole base to the hole placement and corresponding pipe invert elevation to calculate and verify required excavation elevations to maintain pipe grade to project requirements. Verify the manhole components supplied can be constructed to the correct finished grade elevation with components furnished prior to installation. Any identified issues with any of these items shall be reported immediately to the precast manhole manufacturer.

7.2.3 Installer shall verify the delivered frames and covers/grates comply with the project requirements.

7.2.4 If manhole product(s) need to be stored onsite, it is the installer's responsibility to ensure the product is placed on level ground and free from unnecessary mud or debris to prevent damage to the manhole components. Special joint materials: gaskets, lubricant, mastic if furnished shall be stored securely and in accordance with manufacturer's recommendations.

7.2.5 The installing contractor should consult the manufacturer when storing manhole products for periods longer than 30 days.

8. Safety Requirements

8.1 Safety requirements for construction shall be in accordance with all national, regional, and local regulations.

8.2 Manhole components shall only be handled with appropriately rated handling equipment from the safe lift points designated by the manufacturer of the precast manhole sections. Manhole ladders, steps or appurtenances are not to be used as lifting points.

8.2.1 The manhole-lifting apparatus shall meet or exceed safe working load capacity with respect to the lifting points and the unit weight to be handled including all required safety factors as required by code and law within the jurisdiction of the manhole installation. All lifting points shall be used, and the product shall be handled with equal "picking" force on all lifting points.

8.2.2 When lifting manhole bases and risers, make sure the chain or cable lengths are long enough to prevent contact with the manhole joint area and are kept at appropriate lifting angles. Where safe lifting angles cannot be achieved, use appropriately rated spreader bars.

8.2.3 The weight of each section to be handled shall be clearly indicated by marking of the section or on the delivery documents provided to the installer by the precast manhole manufacturer.

8.2.4 Manhole components shall be lifted with equipment appropriate to the application and with sufficient capacity to safely handle the weight of the product.

8.2.5 When transporting manhole components on site it is the installers' responsibility to ensure the speed and mode of transporting the manhole components prevents any possible damage to the product.

NOTE 1—Excessive travel bouncing of the product can introduce unanticipated loadings, cause damage or disassembly of the lifting device to the lifting points.

9. Excavation and Shoring

9.1 The excavation size shall allow for the overall assembled height of the manhole structure including any fabricated sump, plus the height of any grade ring sections, a manhole frame and cover, and any bedding material required. The excavation shall have sufficient width and length, in accordance with local, state, and federal regulations, to ensure safe installation and when compaction of the backfill is required.

9.2 When material unsuitable for installing the manhole components is encountered during excavation it shall be removed to the requirements on the project drawings or as specified by the engineer. Over-excavated areas shall be backfilled with engineer approved materials specified for the leveling course.

9.3 The contractor shall make such provisions as required to ensure adequate drainage of the trench to protect the leveling course during the construction operations. Where surface water or groundwater conditions exist, the site and trench shall be dewatered to a level that will provide satisfactory installation.

9.4 Shoring if utilized for construction shall be in accordance with all national, regional and local regulations.

9.5 If shoring is to be removed it shall be done in accordance with the shoring manufacturer's recommendations or approved safe construction practices. The installer shall use the appropriate lifting equipment to safely remove the shoring and to prevent any disturbance or damage to the manhole.

9.6 Voids in the sidefill that are created by movement of the shoring shall be filled and compacted in accordance with **12.7**.

10. Foundation

10.1 The foundation shall be moderately firm to hard in situ material, stabilized soil, or compacted fill material with adequate bearing capacity to support the manhole structure as specified by the engineer or project requirements.

10.2 When unsuitable or unstable material is encountered, the foundation shall be stabilized or removed and replaced with firm and stable foundation material with adequate bearing capacity to support the manhole structure.

NOTE 2—In the presence of high ground water encountered during excavation the installer may choose to excavate to depths greater than required for a dry installation for the purpose of water control. The purpose is for the placement of open graded course aggregate within the soil bedding area, and possibly the use of mechanical pumps to vacate the excess water. When groundwater flow is anticipated, consideration shall be given to the potential of migration of soil fines from the adjacent

materials into the open graded course aggregate, which can lead to the loss of manhole structure support. Methods to prevent soil migration shall be provided.

10.3 Manhole sections installed over an unyielding foundation, including concrete, shall be cushioned so as to prevent non-uniform bearing in accordance with Section 11.

11. Leveling Course

11.1 After the required elevation of the excavation has been reached and a stable foundation, as required by the project specifications, has been achieved, the area where the manhole structure is to be located shall be levelled evenly across the excavation.

11.2 A minimum 3 in. [75 mm] thick leveling course in an area not less than manhole base area but preferably 6 in. [150 mm] beyond the outside radius of the manhole base, as shown in Fig. 1, shall be constructed of clean coarse grained soils: USCS SW, SP, GW, GP or any soil beginning with one of those symbols and with 12 % or less passing a #200 [75 μm] sieve (AASHTO M145, A-1, A-3). The nominal maximum aggregate size within the leveling course shall not be greater than 1 in. [25 mm] (#57 aggregate). In the event that the leveling course consists of layers with the upper layer being clean, uncompacted sand, that layer shall be a maximum thickness of 2 in. [50 mm] to prevent non-uniform settlement from personnel and equipment during the installation process.

11.3 In situ materials that provide(s) a suitable leveling course in accordance with this practice or approved by the engineer shall be acceptable.

11.4 Any and all in situ materials not meeting the requirements of the project specifications shall be removed and replaced with approved materials.

11.5 The soil levelling area under the manhole structure shall be of uniform stiffness and thickness to the project specifications with even compaction throughout. Local ground conditions may require additional leveling course thickness per project specifications, the engineer’s recommendations, or the installers judgment.

11.6 The soil foundation area or bedding under incoming and outgoing pipes should be treated the same as the manhole base section to prevent settlement or shearing of pipes and to provide proper alignment for the watertight connector/pipe interface if resilient rubber connectors are being used.

11.7 A concrete slab is not an appropriate leveling course.

12. Manhole Installation and Joining

12.1 *General:*

12.1.1 Consult the detailed plan for the correct orientation of the precast concrete manhole to ensure proper alignment with steps, entering pipes, or conduits.

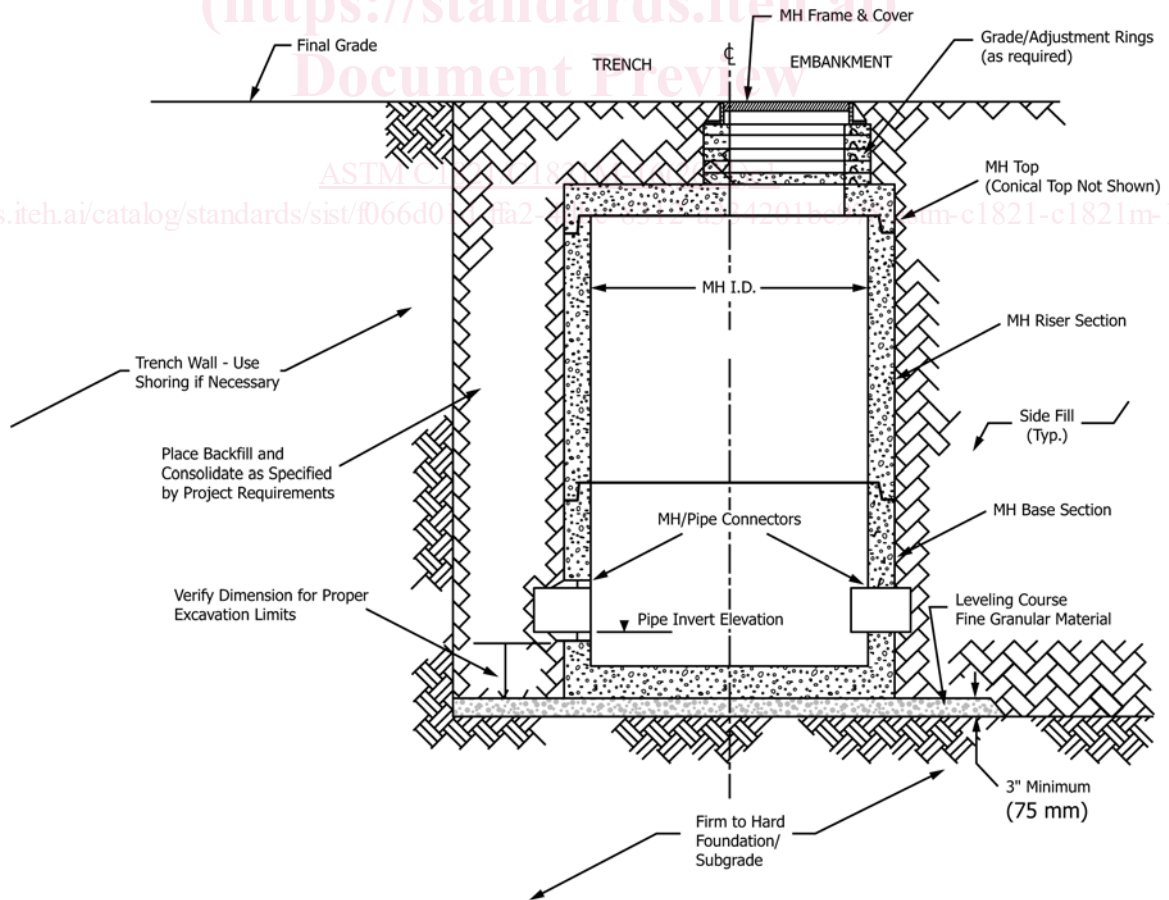


FIG. 1 Manhole Installation Details