



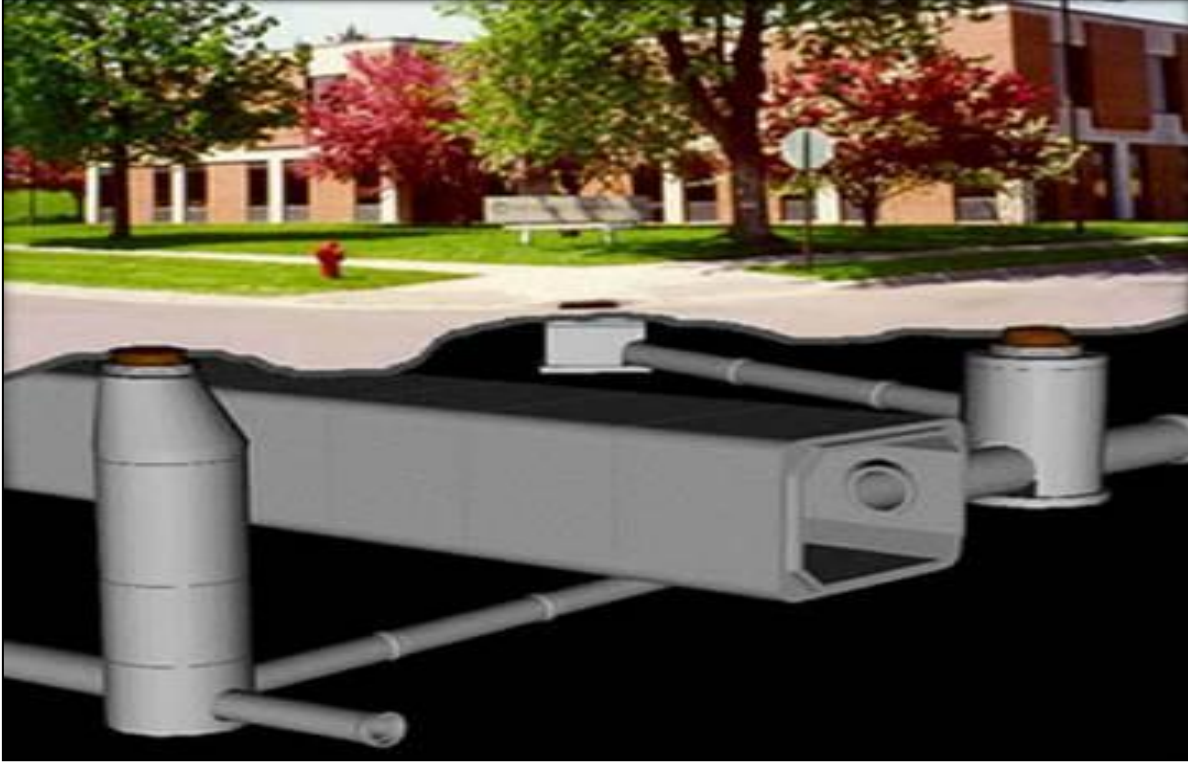
NPCC

Precast ... The Concrete Solution

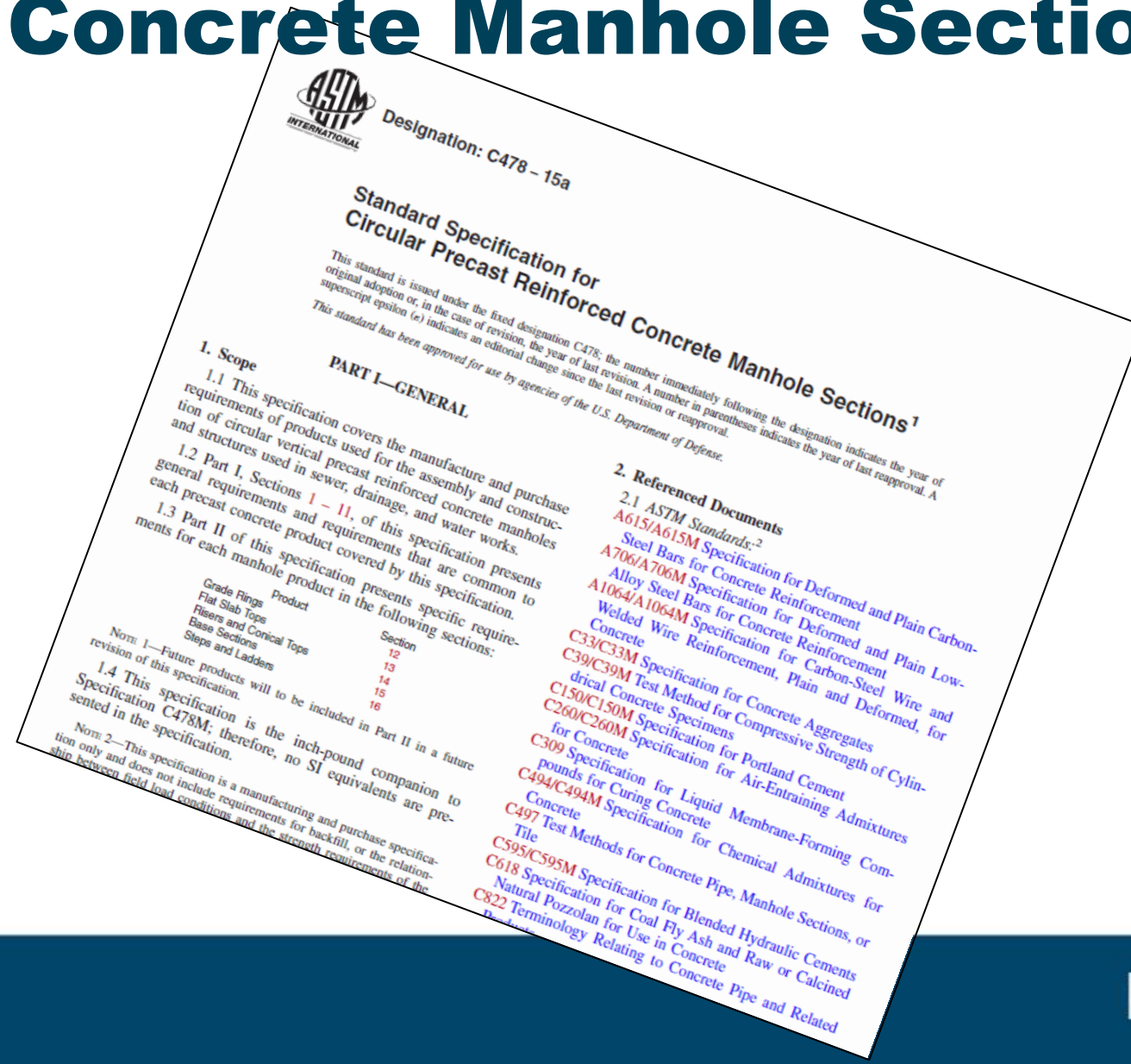
Precast Concrete Manhole Installation

Recommendations of **ASTM C1821**
and the **NPCA**

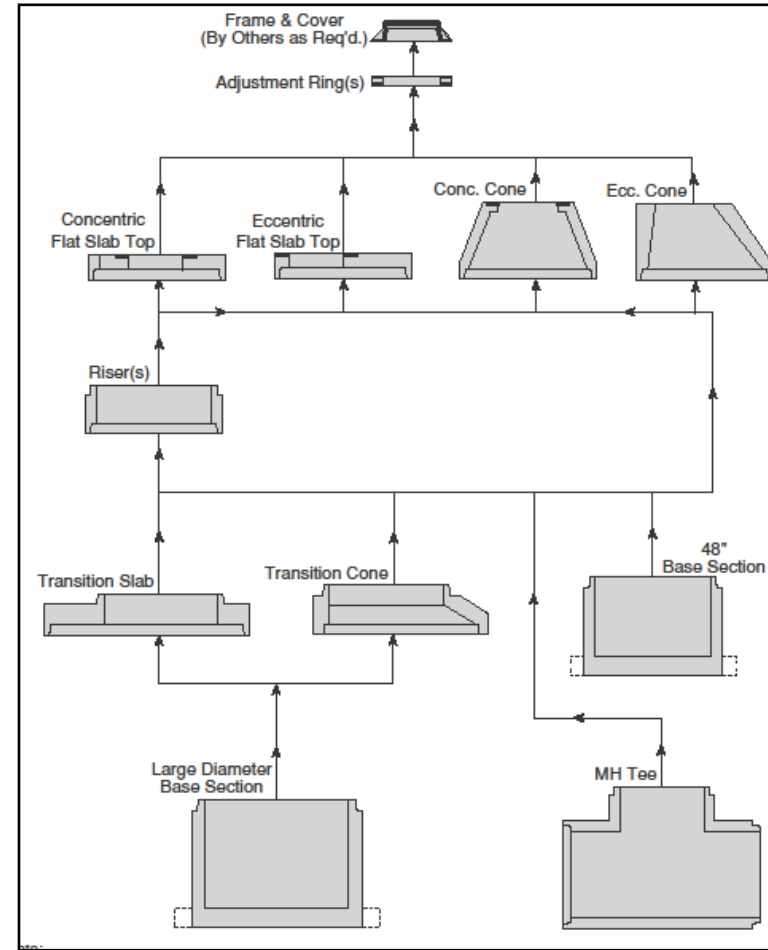
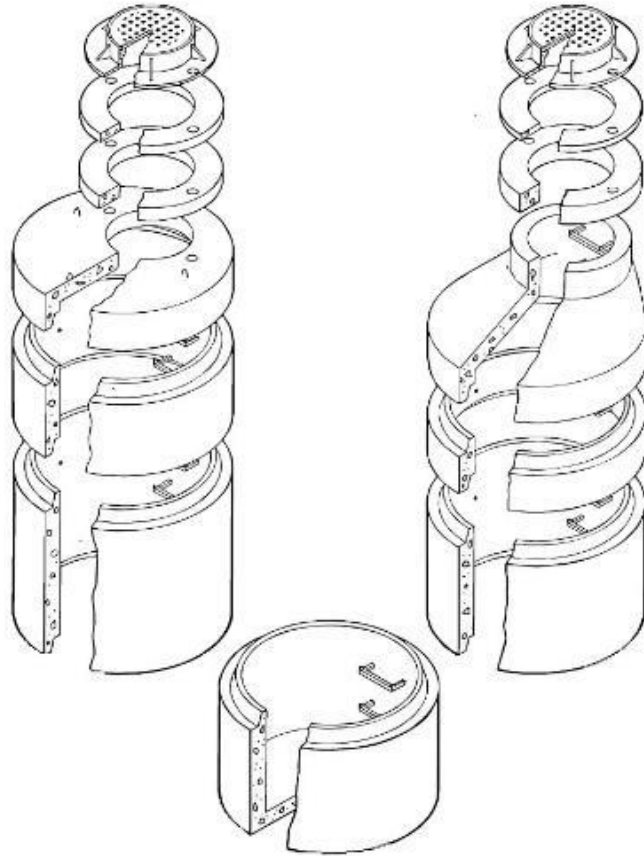
Buried Infrastructure is Critical



ASTM C478 Standard Specification for Circular Precast Concrete Manhole Sections



ASTM C478 Standard Specification for Circular Precast Concrete Manhole Sections

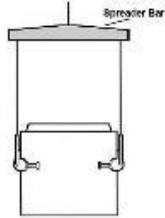


NPCA Manhole Installation Guidelines

RECOMMENDED INSTALLATION PROCEDURES STORM AND SANITARY SEWER MANHOLES

Lifting Apparatus

The approved lifting device shall safely lift the weight of the unit with appropriate lift points (minimum of 18" apart) and safety factor. When lifting manhole bases and risers, make sure the lifting device lengths, including any spreader bars, contact with the tongue and groove area, and do not contact any lifting angles. Where a lifting angle cannot be achieved, use appropriately rated spreader bars. Two manhole lifting apparatus must meet or exceed safe working load capacity with respect to the lifting point. All lifting points should be used, and the product should be handled with equal "pinch" force on all lifting points.



Recommended Manhole Bedding

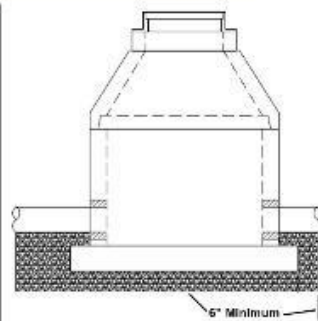
Use a minimum of 6" of approved bedding material compacted to 90% Proctor in an area that is 6" beyond the outside radius of the manhole base. Do not use any material less than the base area but preferably 6 inches beyond the outside radius of the manhole base. Do not use any material and outgoing pipes should be tested the same as the rest of the pipe. Do not use bedding alignment for the sewer/drain connected pipe interfaces. If connections are being utilized, proper ground conditions may require additional bedding thickness, based on the intended use and conditions.

Handling Manhole Components

Manhole components should not be moved using backhoes or front-end loaders, unless they are of sufficient capacity to handle the product. Avoid transporting precast concrete manhole components at a speed that causes the product to bounce. Excessive lateral loading of the product can cause damage. Also avoid using a rolling ramp to load product and the ground will cause some misalignment.

Setting the Manhole Base and Risers

Set the manhole base on a graded bedding per job specifications, making sure the connectors or pipe openings are in line with the riser. Use the top of the manhole base to align the riser. Make sure each additional riser section is properly installed before installing the next riser, cone or cap.



Use a minimum of 6" of approved bedding material compacted to 90% Proctor in an area that is 6" beyond the outside radius of the manhole base.

Pipe Connections

See the following recommendations for pipe connections. Check with the manufacturer if precast inserts are supplied.

Flexible Bolt Connections – Clean the pipe surface and inside of pipe. Insert the pipe flush with the inside of the manhole wall. Do not allow any tensioning, causing the pipe to distort in the corners. Install all tie rods (clamps) in a straight line. If available, use the outside part of the manhole. Tighten the clamp to the recommended torque, which will vary depending on size and manufacturer's specifications. Check for uniformity of the clamp and ensure the pipe is installed in alignment for proper sealing of the clamp. Any gasketing that will inhibit the designed flexibility of the connector should be avoided.

Compression Type Connector – Cut a notch in the end of the pipe to be inserted into the manhole. Use the pipe and connector surface and the inside area of the connector. Lubricate the surface of the connector and exterior area of the pipe being inserted with the approved lubricant. Center the beveled end of pipe into the connector. Keeping the beveled portion of the pipe into the connector until the pipe is flush with the inside of the hole wall or as required per local specifications.

Mortar Joint – Set the pipe into the opening to meet specifications. Using non-shrink mortar, fill the voids around the pipe completely. Allow to cure during the below backfilling.

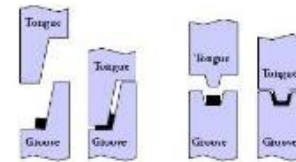
Pipe Stubs

Any pipe stubs left in the manhole must be protected from movement to prevent blowout, resulting from ground water or any testing.

Joint Installation

Please follow the following instructions:

Butyl Gasket – Use only manufacturer recommended gaskets for specific diameters. Clean and inspect tongue and groove surfaces. Surfaces should be free from dirt and debris. On the tongue of the manhole, place butyl material next to the external surface of the groove. Wrap the material completely around the unit overlapping areas. Knive the area together to form a unified joint. Make sure all protective paper is removed. Lower the unit and of the next unit, making sure a minimum of 1/4" of gasket is visible in the final position. If the butyl is not completely visible in the joint, the surface of the gasket is not fully seated.



Confined O-Ring

Clean and inspect joint surfaces. Lubricate the joint with the following: 1. Lubricate the O-ring gasket thoroughly before placing it into the confined groove spaces provided. 2. Use a smooth round object between the gasket and tongue around the entire circumference several times to equate the gasket diameter. 3. Lower the lubricated end of the next unit, making sure steps are aligned into the final position. 4. Keep units plumb while setting to avoid the gasket from rolling out of the confined groove, which could result in breaking the unit.

Offset and Prelubricated Gaskets

Install per the manufacturer's specifications.

Precast Lift Hole Sealing

Any penetration required by an authority with inspection, lifting holes should be sealed by installing a rubber plug or other approved material into the hole. If a plug is used, it should be filled with non-shrink mortar from inside and outside. When using embed anchors, voids should be filled with non-shrink grout.

Backfill Procedure

Backfilling of the manhole is required to prevent floating. Backfill the lift hole with concrete to the standard finish. Backfill the lift hole with concrete to the standard finish. Backfill the lift hole with concrete to the standard finish. Backfill the lift hole with concrete to the standard finish.

Testing Procedures

Manhole testing should be performed before backfilling. Use a minimum of 1/4" of gasket is visible in the final position. If the butyl is not completely visible in the joint, the surface of the gasket is not fully seated.

Storage

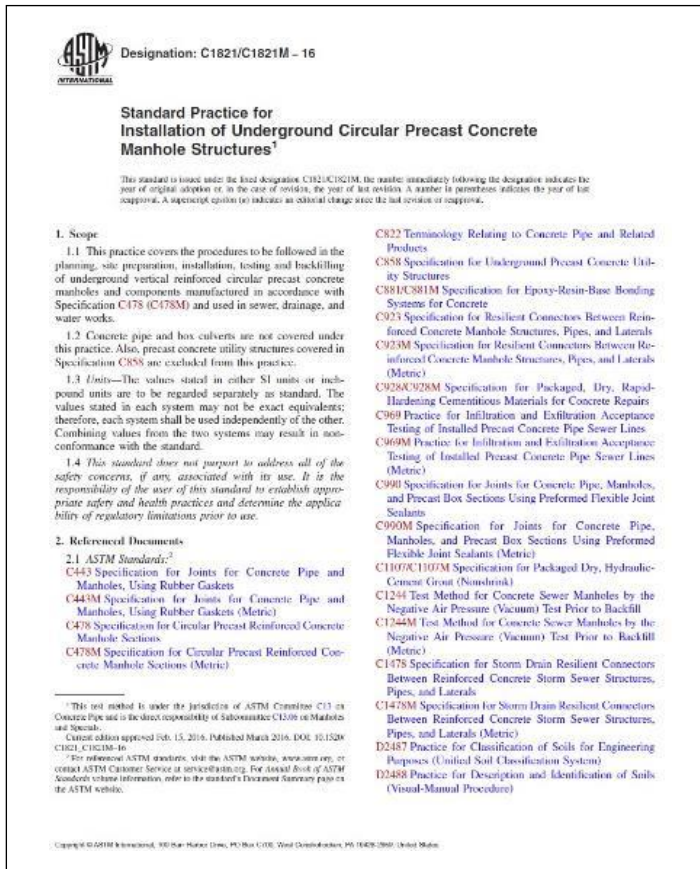
Manhole products need to be stored properly, making sure they are stored on level ground and not in contact with water to prevent damage. Damage can be used in those situations to avoid problems. Please consult with the manufacturer when storing manhole products for long periods.

Disclaimer

This manual is not intended to replace any other safety manual. It is only intended to be used as a guide. The manufacturer's products, concrete manholes, may involve the use of hazardous materials, operations, and equipment. It is the user's responsibility to determine appropriate safety, health and environmental practices, and applicable regulatory requirements associated with the use of this manual and the manufacture or precast concrete products.

The user of these products is advised to purchase the proper fire protection for the use of the product. The user of these products is advised to purchase the proper fire protection for the use of the product. The user of these products is advised to purchase the proper fire protection for the use of the product.

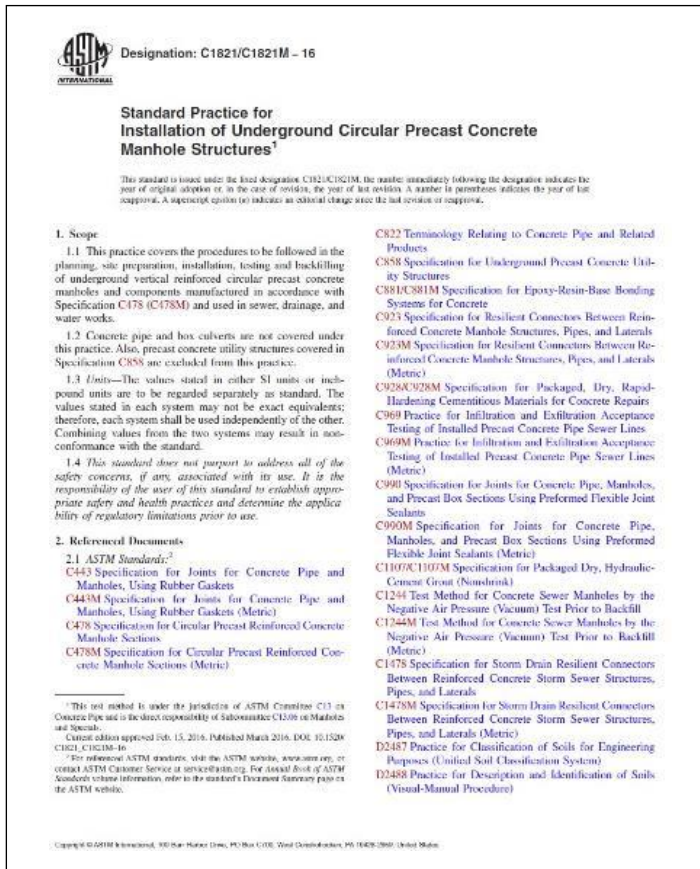
ASTM C1821-16 Installation of Underground Circular Precast Concrete Manhole Structures



- Scope
- Referenced Documents
- Terminology
- Significance and Use
- Site Inspection
- Planning
- Delivery
- Safety Requirements
- Excavation and Shoring
- Foundation
- Leveling Course
- Manhole Installation and Joining
- Testing
- Keywords

Purchase Complete ASTM Standard at <https://www.astm.org/Standard/standards-and-publications.html>
Or included within the NPCA Selected ASTM Standards for Precast and Prestressed Concrete

ASTM C1821-16 Installation of Underground Circular Precast Concrete Manhole Structures



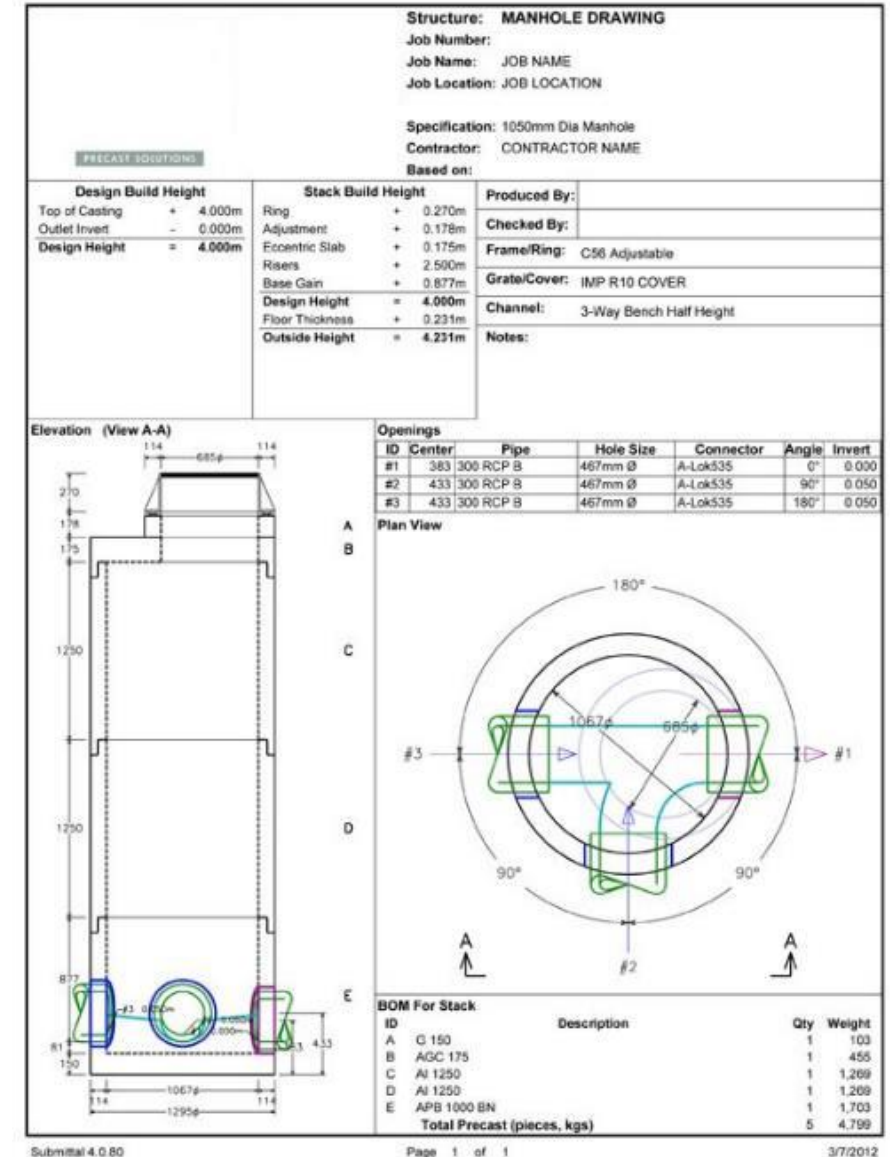
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ASTM Manhole Installation

Part 1 – Delivery, Handling and Storage

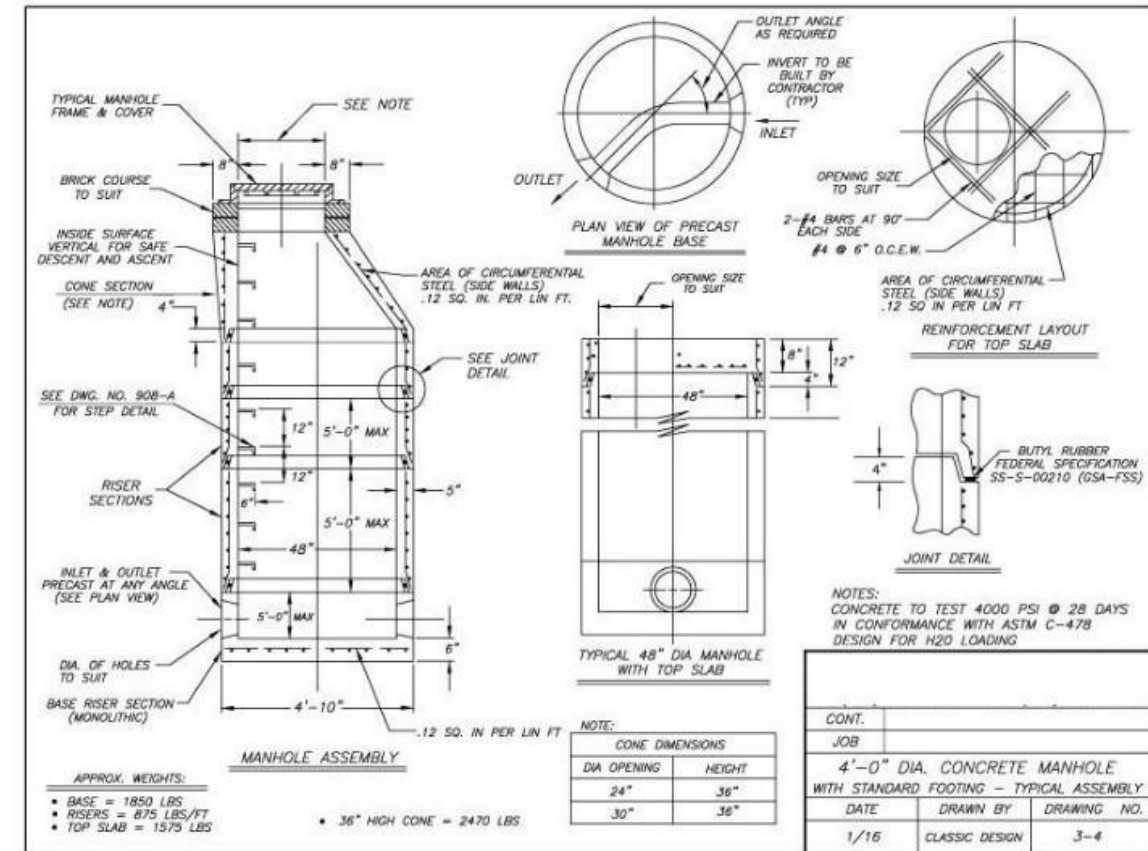
Section 6: Planning

- **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.



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Manhole Project Installation

Delivery Time!



ASTM C1821/C1821M

Section 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.



ASTM C1821/C1821M

Section 7: Delivery

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Section 8: Safety Requirements

- **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.
- **8.2.2:** 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.



Section 8: Safety Requirements

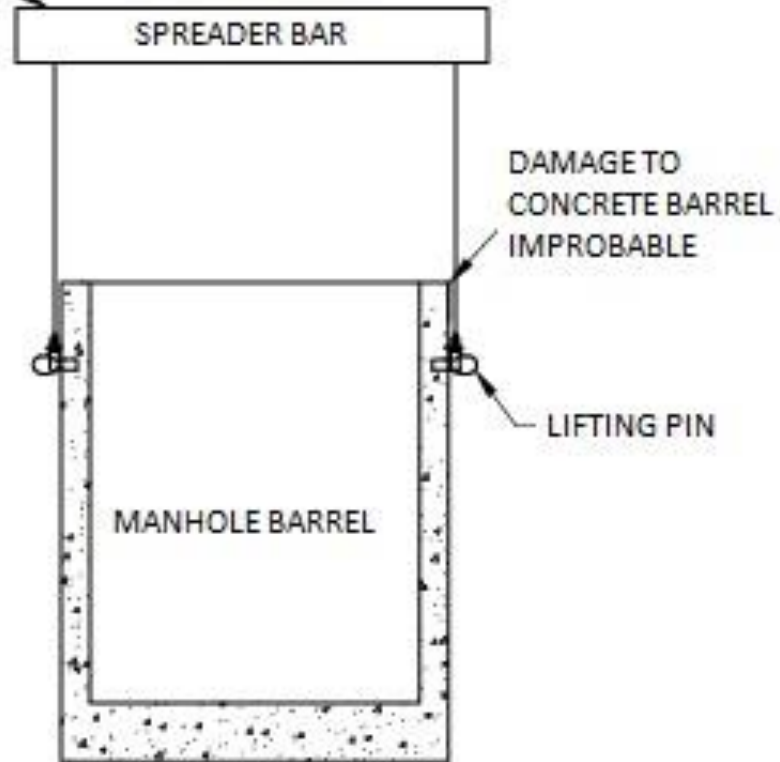
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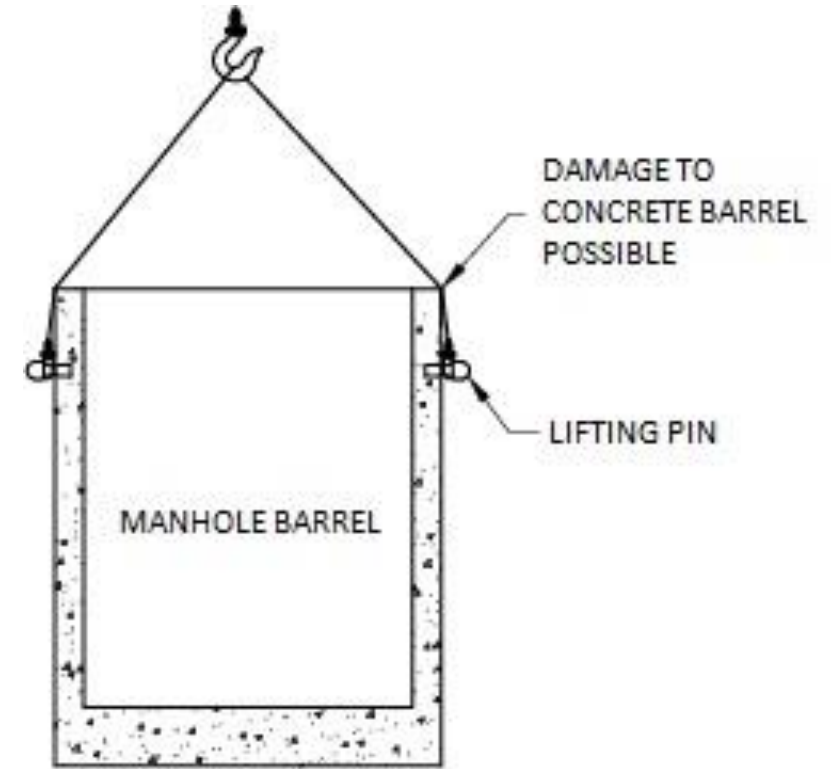


Lifting with a spreader bar

USE SPREADER BAR LONG ENOUGH
TO ALLOW FOR A VERTICAL PICK



Vs.



Lifting with a spreader bar

ASTM C1821/C1821M

Section 7: Delivery

- **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.



ASTM C1821/C1821M

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ASTM C1821/C1821M

Section 7: Delivery

- **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. If the damaged manhole component cannot be repaired in accordance with Specification C478, that component shall not be installed.



ASTM C1821/C1821M

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Section 7: Delivery

- **7.2.2:** The installer shall measure the received manhole components upon delivery to verify the products furnished are in compliance with the approved shop drawings. This includes but is 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.



ASTM C1821/C1821M

Section 7: Delivery

- **7.2.4:** Special joint materials: gaskets, lubricant, mastic if furnished shall be stored securely and in accordance with manufacturer's recommendations.



ASTM Manhole Installation

Part 2 – Excavation & Bedding Preparation

ASTM C1821/C1821M

Section 6: Planning

- **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.



Section 6: Planning

- **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 the opportunity to alter production of the manhole structure.



Section 9: Excavation and Shoring

- **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.



Section 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.
- ***NPCA Guidelines:*** Use a minimum of 6 inches of approved bedding material compacted to 90% proctor in an area not less than the base area but preferably 6 inches beyond the outside radius of the manhole base.



Section 11: Leveling Course

- **11.2:** A minimum 3 inches [75 mm] thick leveling course in an area not less than manhole base area but preferably 6 inches [150mm] beyond the outside radius of the manhole base, as shown in Figure 1. The nominal maximum aggregate size within the leveling course shall not be greater than 1 inch.
- **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.



Section 11: Leveling Course

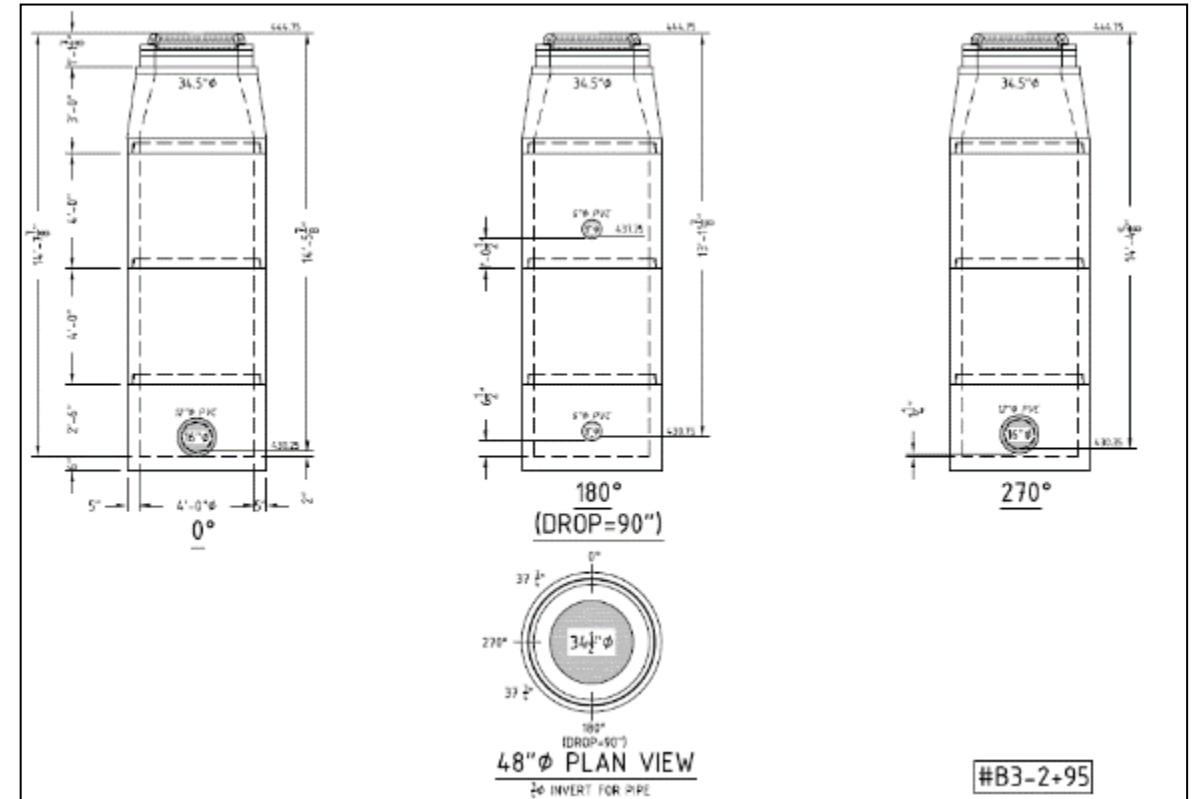
- **11.5:** The soil levelling area under the manhole structure shall be of uniform stiffness and thickness to the project specifications with even compaction throughout. Local ground conditions may require additional leveling course thickness per project specifications, the engineer's recommendations, or the installers judgment.
- ***NPCA Guidelines:*** Use a minimum of 3 inches of approved granular material loosely placed in an area not less than the base area but preferably 6 inches beyond the outside radius of the manhole base.



Section 11: Leveling Course

- **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.

Field drawing of a manhole showing rim and flow line elevations and section heights.



ASTM Manhole Installation

Part 3 – Installing and Joining

Section 12.3: Manhole Placement

- **12.3.1:** Set the manhole base on the leveling course making sure the manhole base section is firmly in place and the connectors or pipe openings match design orientation. Verify the top of the manhole base is level in two directions perpendicular to each other.
- **12.3.2:** Verify the manhole base section pipe openings and/or connectors are at proper grade for pipe inverts to match design elevations.
- **12.3.3:** Assemble multi-section manhole structures by lowering each section into the excavation. As they are installed, verify each additional riser section is plumb and the joint homed before installing the next riser, conical top or flat slab top.



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ASTM C1821/C1821M

Section 12.3: Manhole Placement: **Alignment**

Get the first one right!

Typical tolerance

- 2 inches per 16 feet

There is no consensus on permissible plumb tolerance. It is the responsibility for the authority having jurisdiction to specify the tolerance expectations if needed within the contract documents prior to enforcing a specific plumb tolerance



ASTM C1821/C1821M

Section 12.3: Manhole Placement

- **12.3.4:** Install the conical top or flat slab top as shown on the approved shop drawing plumb and in alignment similar to the preceding barrel or base section.
- **12.3.6:** Place adjusting grade rings (if required) along with mastic sealant and frame with cover/grate to achieve specified finished grade.



ASTM C1821/C1821M

Section 12.3: Manhole Placement

- **12.3.5:** Adjacently placed manhole sections shall be aligned to match the step placement of the preceding section if steps are provided. Tolerance of step alignment shall be in accordance with Specification C478 (C478M). ASTM C478 states steps shall be aligned.

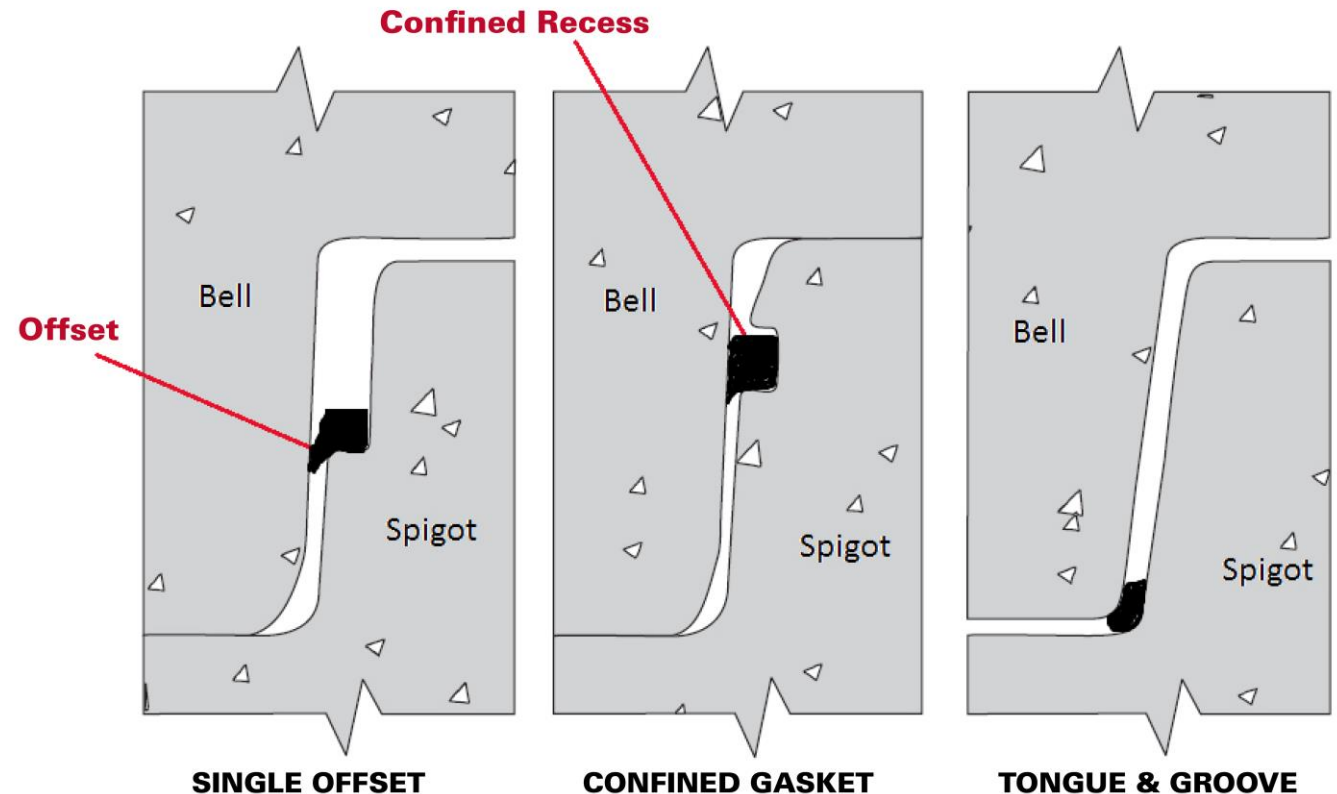
Note: C478,

Section 16.5.5: *The vertical spacing and vertical alignment between adjacent manhole steps and horizontal distance from the inside wall to the centerline of a manhole step may vary 1 inch from the design dimension.*



Section 12.4: Joints and Joining

- **12.4.1:** To ensure joint integrity when assembling the manhole structure the installation contractor is responsible to maintain clean joint surfaces, removing all foreign materials that could damage or impair the jointing surfaces or gasket materials.
- **12.4.2:** All joints shall be installed in accordance with the manhole manufacturer's recommendations using only the materials supplied with the manhole structures.
- **12.4.3:** Manhole joints that utilize resilient rubber gaskets shall be in accordance with Specification C443 (C443M).
- **12.4.4:** Manhole joints that utilize mastic sealing material shall be in accordance with Specification C990 (C990M).



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ASTM Manhole Installation

Part 4 – Connecting Pipes to Manholes and Field Cutting or Coring

Section 12.6: Pipe-to-Manhole Connections

- **12.6.1:** When resilient pipe-to-manhole connectors are furnished, they shall be furnished as follows unless prohibited by project specification:
- **12.6.1.1:** *Sanitary Sewer, Water Reclamation or Reuse Applications* – Specification C923 (C923M), Specification F2510/F2510M.
- **12.6.1.2:** *Storm Sewer Applications* – Specification C1478 (C1478M), Specification F2510/F2510M.
- **12.6.1.3:** Installation of the pipe utilizing the resilient pipe-to-manhole connectors is to be in accordance with the furnished manufacturer's recommendations. When completed, the pipe inverts shall meet the required elevations.



Two Primary Types of Pipe to Manhole Connectors



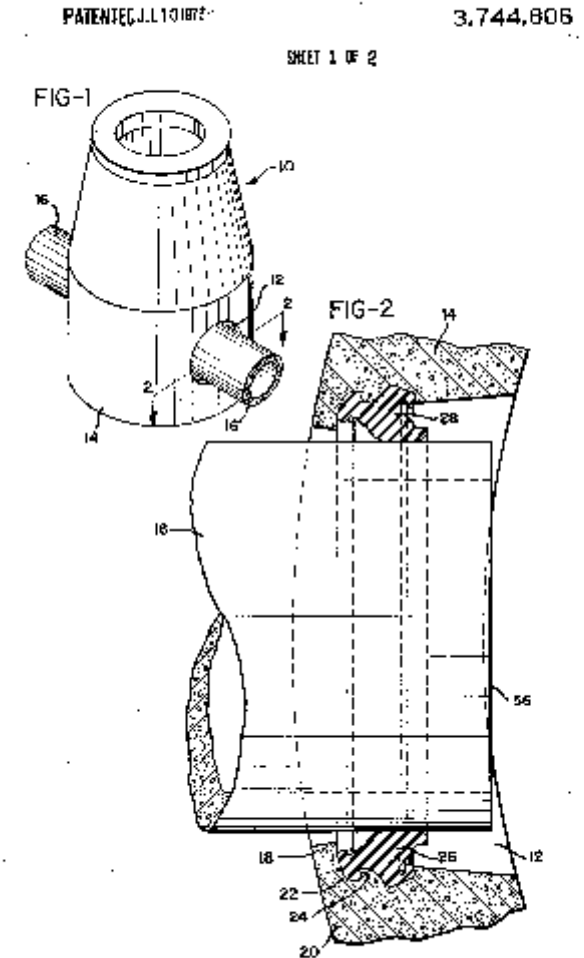
Boot Type



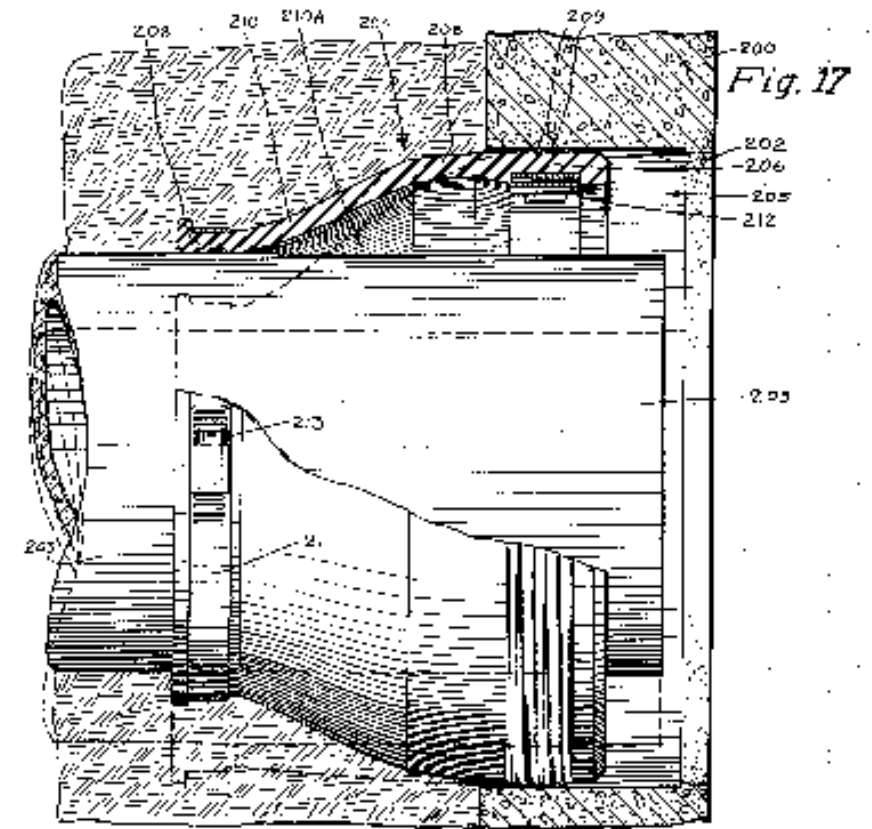
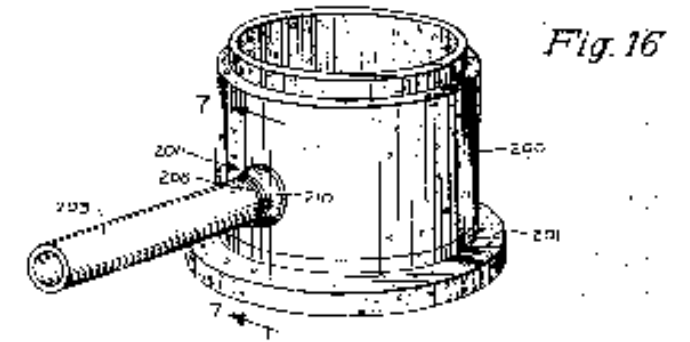
Compression Type



Compression Type Connector



Boot Type Connector



ASTM C1821/C1821M

Section 12.6.3: Field Cut Pipe Openings

- **NOTE 3** – Some manhole steel designs such as permissible hoop steel for 48 in. [1200 mm] diameter manholes do not permit pipe openings within the barrel sections. Unanticipated field cuts may require additional design analysis.
- **12.6.3.1:** Any field cut of the manhole structure required for a pipe opening shall be approved by the engineer



Section 12.6: Pipe-to-Manhole Connections

- **12.6.2:** If permitted by project specification or engineer, the installer may choose to use a cementitious non-shrink grouted pipe connection.
- **12.6.2.1:** Cast or cored openings of cementitious grouted connections shall not exceed pipe outside diameter plus 6 inches (150 mm), unless a larger opening is permitted by the engineer.
- **12.6.2.2:** Any pipe ends to be grouted into place shall have a water-stop assembly or material applied on the pipe end, which will be encased within the grouted connection.



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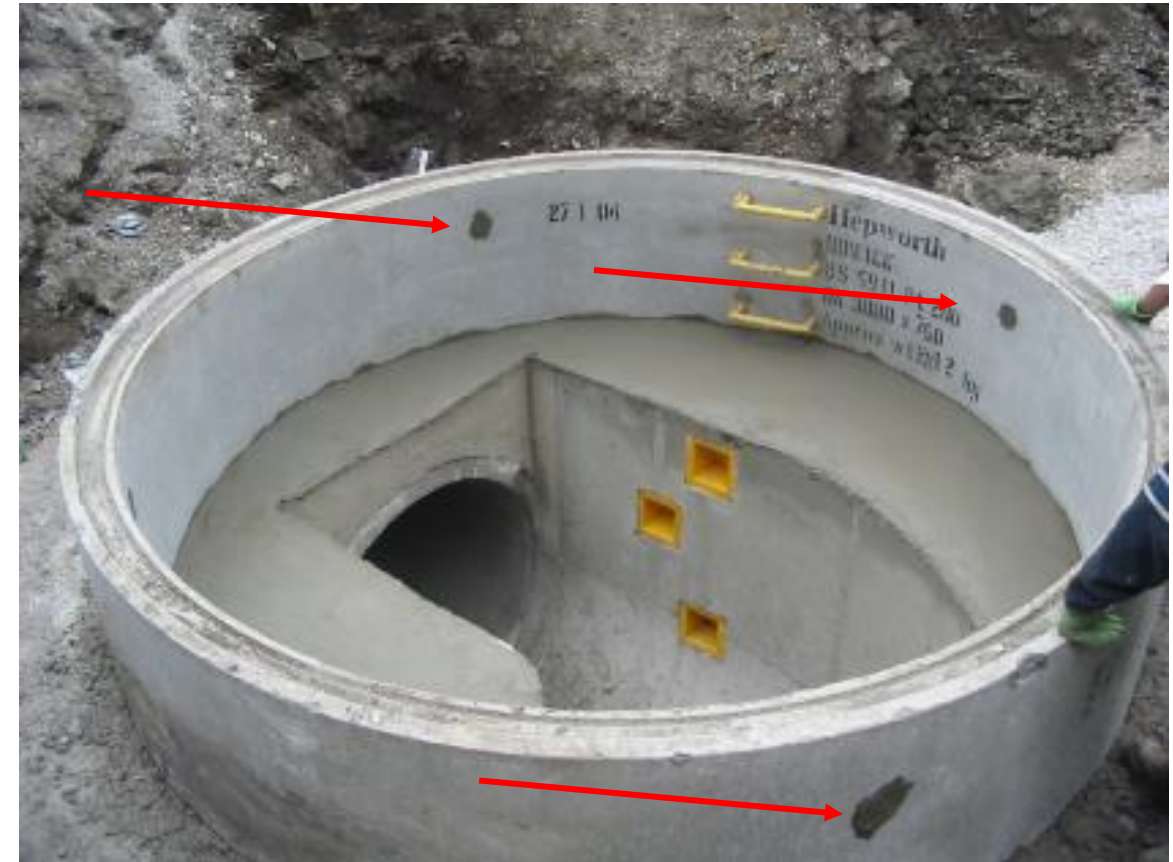
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Section 12.5: Lift Hole Sealing

- **12.5.1:** Lifting holes (full penetration “see through”) shall be sealed by inserting into the hole a rubber or plastic plug, precast plug with mastic sealant or with an approved cementitious material (or filling the opening with non-shrink grout from inside, outside, or both).
- **12.5.2:** Lifting holes (full penetration “see through”) when employed as weep holes by design shall be sealed by securing outside placement of an approved non-woven geotextile fabric over the opening to eliminate soil migration but permit water flow.
- **12.5.3:** If required by project specifications. Embedded or cast-in lift anchors (“non-see through”) shall have the exposed small pocket volumes filled with non-shrink grout or with an impervious mastic material.



ASTM C1821/C1821M

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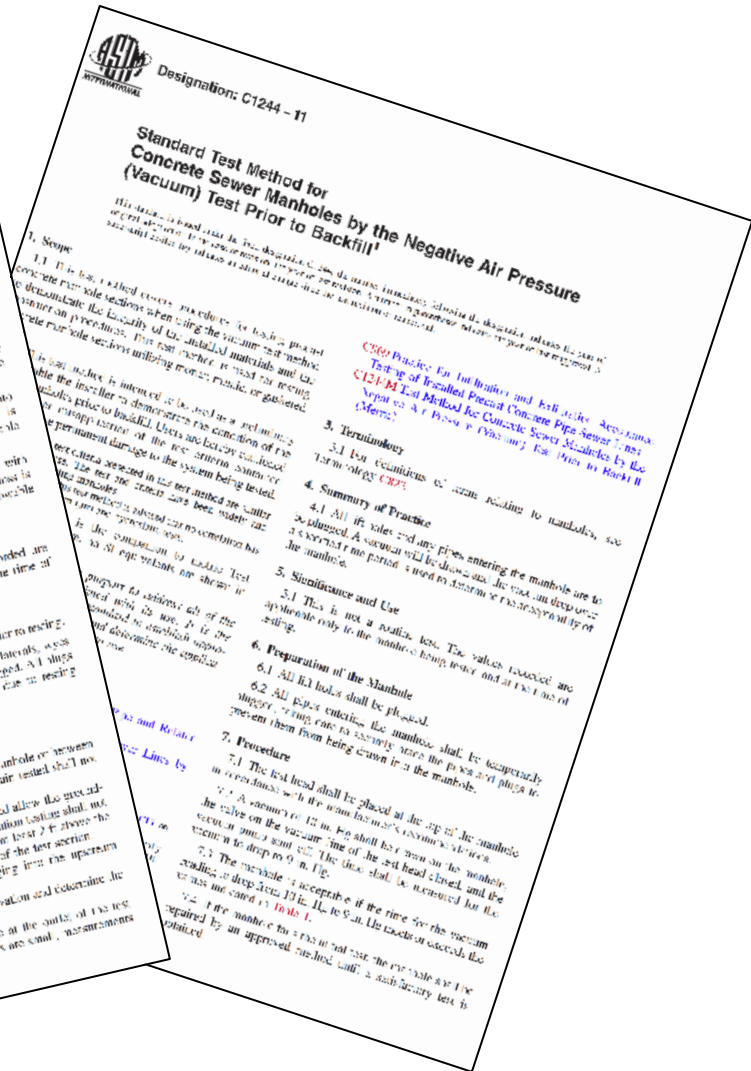


ASTM Manhole Installation

Part 5 – Testing and Backfilling

Section 13: Testing

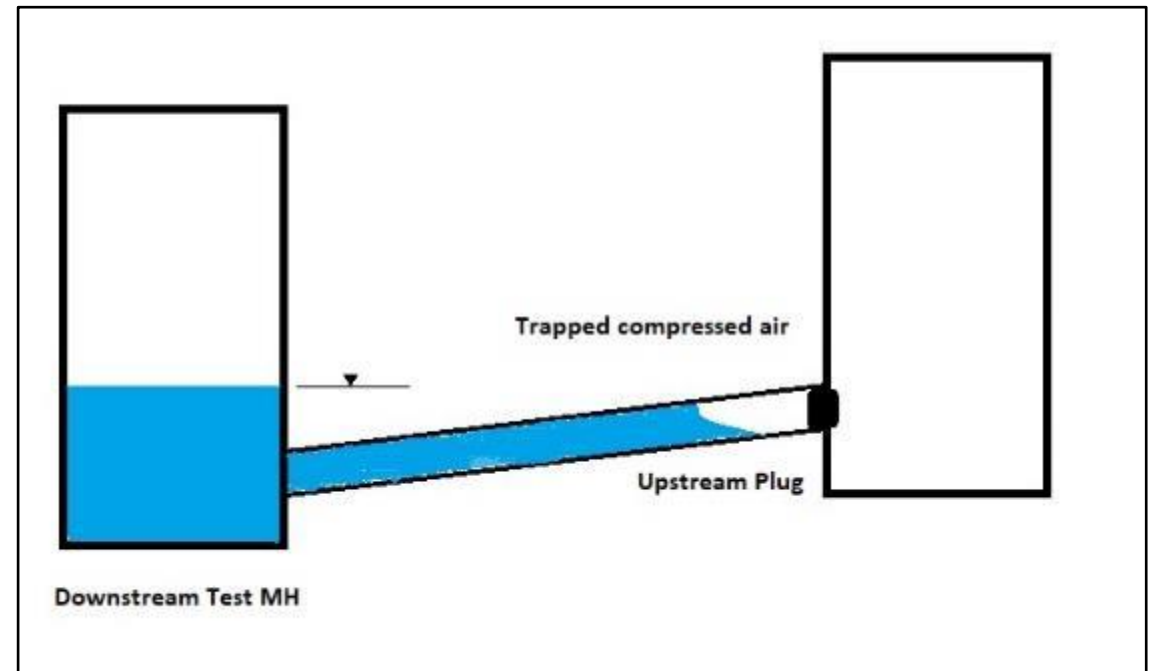
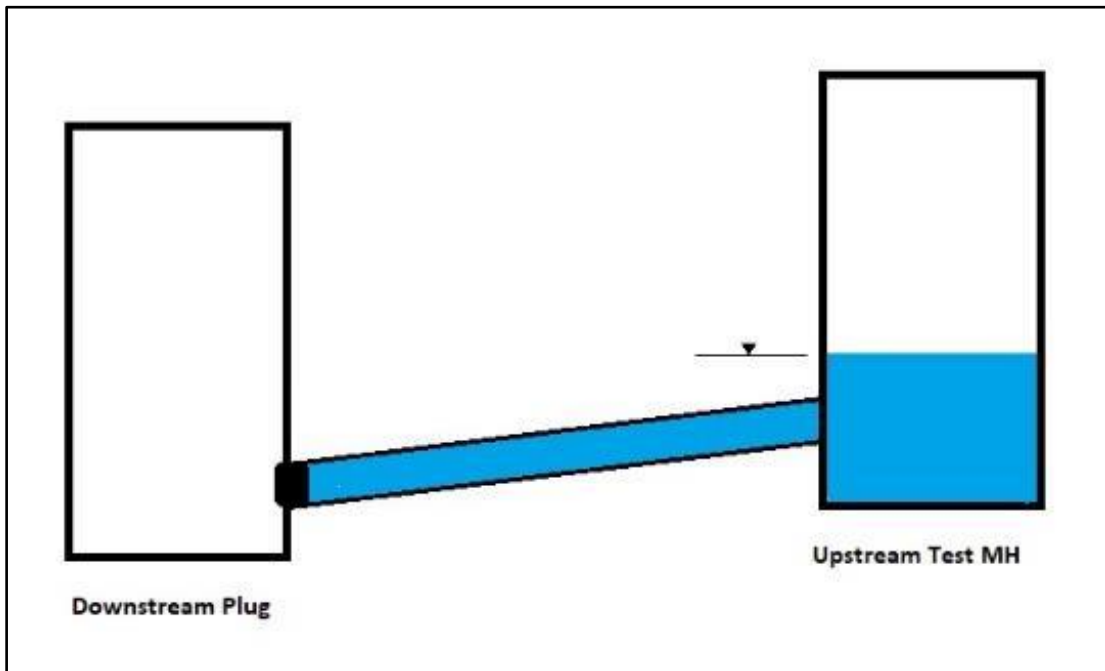
- **13.1:** When required by the owner or designated by the project specification, the installer shall successfully test the completed manhole structure in accordance with the following methods:
 - **13.1.1:** Practice C969 (C969M)
 - **13.1.2:** Test Method C1244 (C1244M)



ASTM C1821/C1821M

Section 13: Testing

ASTM C969 Hydrostatic Test



ASTM C1821/C1821M

Section 13: Testing

ASTM C1244



C1244 – 05a^{e1}

TABLE 1 Minimum Test Times for Various Manhole Diameters
(30 – 120 In.) In Seconds

Depth (ft)	Diameter, in.								
	30	33	36	42	48	54	60	66	72
Time, in seconds									
<4	6	7	7	9	10	12	13	15	16
6	9	10	11	13	15	18	20	22	25
8	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	66	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	36	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

TABLE 1 Minimum Test Times for Various Manhole Diameters
(30 – 120 In.) In Seconds (continued)

Depth (ft)	Diameter, in.							
	78	84	90	96	102	108	114	120
Time, in seconds								
<4	18	19	21	23	24	25	27	29
6	26	29	31	34	36	38	41	43
8	35	38	41	45	48	51	54	57
10	44	48	52	56	60	63	67	71
12	53	57	62	67	71	76	81	85
14	62	67	72	78	83	89	94	100
16	70	76	83	89	95	101	108	114
18	79	86	93	100	107	114	121	128
20	88	95	103	111	119	126	135	142
22	97	105	114	122	131	139	148	156
24	106	114	124	133	143	152	161	170
26	114	124	134	144	155	164	175	185
28	123	133	145	155	167	177	188	199
30	132	143	155	166	178	189	202	213



Testing an Installed Manhole Can Be Problematic



Testing an Installed Manhole Can Be Problematic



VACUUM TESTING PRECAST CONCRETE MANHOLES

HYDROSTATIC PRESSURE
the pressure created by
height (h) of the
a unit

ACU PRECAST

HYDROSTATIC PRESSURE

The pressure created by a fluid is a function of the fluid's unit weight and the height (h) of the liquid column above a reference plane. Water, for example, has a unit weight of 62.4 psig per foot of water column height, which corresponds roughly to a 2.31 foot water column is roughly to psi gauge (psig) or 2.31 psi absolute (psia). Following are a series of expressions that illustrate the relationship between the unit weight of water and its corresponding gauge pressure per foot of water column height and the example solution for the pressure created by a 23-foot water column.

$$62.4 \frac{\text{lbs}}{\text{ft}^3} \times \frac{1 \text{ ft}^3}{1728 \text{ in}^3} \times \frac{12 \text{ in}}{1 \text{ ft}} = 0.433 \frac{\text{psig}}{\text{ft}}$$
$$P_{\text{hydrostatic}} = \gamma_{\text{water}} \times h_{\text{water column}}$$
$$62.4 \frac{\text{lbs}}{\text{ft}^3} \times 23 \text{ ft} = 1435.2 \text{ psf}$$

$62.4 \frac{\text{lbs}}{\text{ft}^3} \times \frac{1 \text{ ft}^3}{1728 \text{ in}^3} \times \frac{12 \text{ in}}{1 \text{ ft}} = 0.433 \frac{\text{psig}}{\text{ft}}$
 $P_{\text{hydrostatic}} = \gamma_{\text{water}} \times h_{\text{water column}}$
 $9.967 \frac{\text{lbs}}{\text{in}^2} \approx 10 \text{ psig}$ or $23 \text{ ft} \times 0.433 \frac{\text{psig}}{\text{ft}} = 10 \text{ psig}$

CREATING A VACUUM

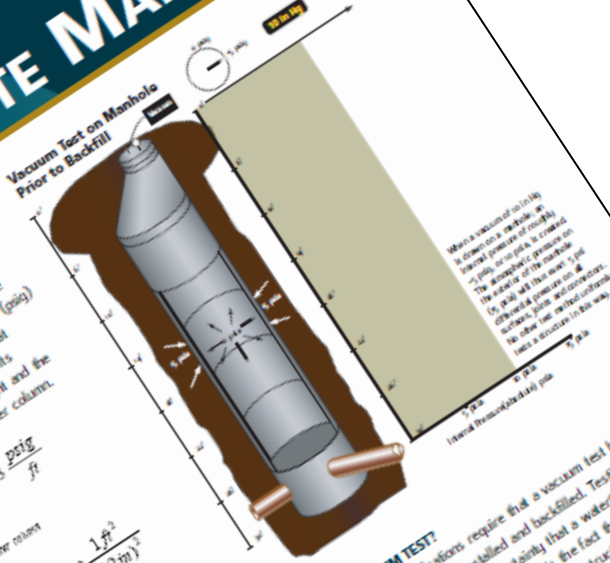
$\frac{(b_2 - b_1)}{h} \approx 10 \text{ psig}$ or $9.959 \text{ psig} \approx 10 \text{ psig} = 23 \text{ ft}^3 \cdot 0.433 \frac{\text{ft}}{\text{ft}} = 10 \text{ ft}^3$

CREATING A VACUUM

Vacuum is defined as an absence of matter (molecules) in a defined volume of space. To produce a vacuum in the field we need to remove all the molecules of matter (air) from within an enclosed space (manhole structure). Initially a manhole which has not been backfilled is uniformly loaded by atmospheric pressure (15 psia) on its interior and exterior, creating an equilibrium state. To create a vacuum we use a pump, or venturi nozzle, attached to the manhole and attempt to "suck" out the air. It is almost impossible to produce a total vacuum. The closer we get to a vacuum (50 gpp inches Hg) the harder it gets to encourage the molecules to leave.

To create a partial vacuum (somewhere between 50 gpp inches Hg), which in turn creates a pressure vacuum inside the manhole and the exterior of the manhole.

In reality all we do is create a partial vacuum. The most common is 10 inches Hg, which in turn creates a vacuum of 29.92 inches Hg. The difference between the partial vacuum inside the manometer and the atmospheric pressure pressing against the exterior of the manometer is the vacuum of 10 inches Hg is drawn on a manifold, an internal vacuum of 19.92 inches Hg is created. The atmospheric pressure of 14.7 psi (101.3 kPa) will thus exert 5 psi (34.5 kPa) on the interior of all surfaces, joints and connectors as illustrated in the diagram. This test method uniformly tests a structure



WHEN TO VACUUM TEST?



WHEN TO VACUUM TEST?

Many codes and specifications require that a vacuum test be performed after the manhole has been installed and backfilled. Testing after backfilling provides a degree of certainty that a watertight system has been installed. The major disadvantage is the fact that no industry standards exist for vacuum testing after the structure has been backfilled. Secondly, it is often difficult to determine the cause or locate and repair a system breach once the manhole has been backfilled.

The resolution to this problem is to perform a vacuum test prior to backfilling and, if necessary, again after backfilling.

See Appendix A: Suggestions for detecting leaks

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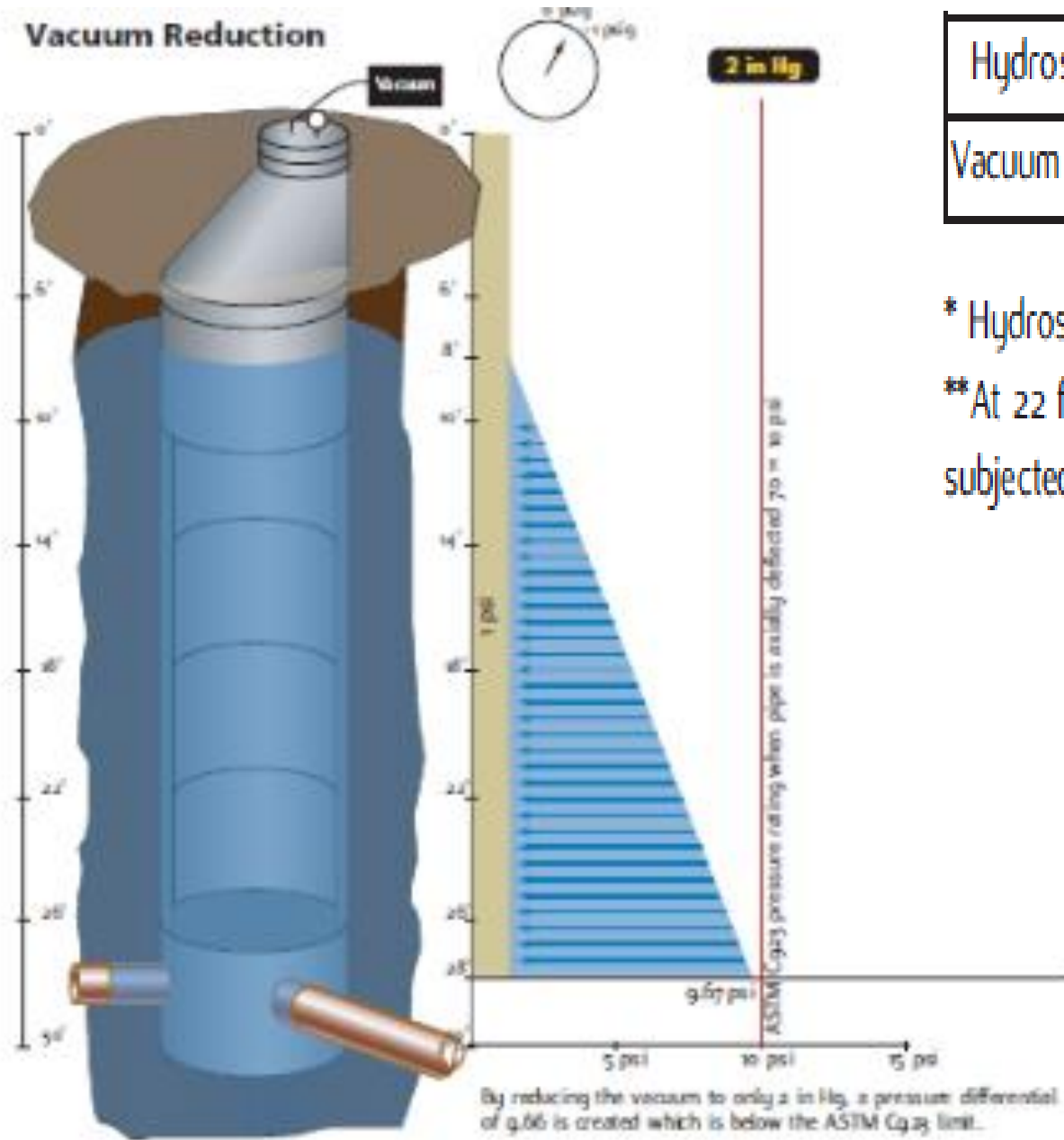
The results of the
backfilling and
See Appendix A: Soil
Internal
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Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill¹

Vacuum Reduction



Hydrostatic Head (ft)*	12	13	14	15	16	17	18	19	20	21	22
Vacuum Pressure (in Hg)	10	9	8	7	6	5	4	3	2	1	**

* Hydrostatic head above critical connector

**At 22 feet below the groundwater table, the connector is naturally subjected to 9.5 psi

Section 12.7: Backfilling and Restoration

- **12.7.2:** Excavations shall be backfilled with an approved or specified soil material free from large stones, rocks, pavement, and other items that could damage the installed manhole structure. Expansive soil material shall not be used as backfill around the structure.
- **12.7.3:** If required by site specifications, when a precast concrete manhole structure is placed in an unpaved area, slope the area around the entrance frame and cover to provide drainage away from the entrance cover. Slope the final grading upward to within 1 inch (25 mm) of the top surface of the frame and cover.



Section 12.7: Backfilling and Restoration

- **12.7.4 Backfill Procedures** – Backfilling shall be achieved by using lifts (layers) and compactive effort or flooding (jetting) the excavation to meet the required soil density requirements. Backfill shall be placed around all sides of the installed section in lifts that shall provide adequate densification and not induce a lateral load shifting the manhole sections. If required by project specification, backfill lifts shall be placed uniformly around all sides of the installed section in lift thickness and with compaction to densities specified.



Section 12.7: Backfilling and Restoration

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ASTM C1821/C1821M

Section 12.7: Backfilling and Restoration

- **12.7.4.1:** The installer is to provide special care and placement of bedding and backfill material under and surrounding pipe connections to manholes to provide firm, uniform support of the pipe at these junctions. This compactive effort is to reduce the potential of pipe shear at the manhole interface due to differential settlement of the surrounding soil.



Section 12.7: Backfilling and Restoration

- **12.8:** Restoration of the area where the circular manhole structure was installed shall meet the requirements of the project requirements or the engineer.
- **12.9:** Follow-up inspections for settlement are required. Should settlement occur, the contractor shall be responsible for the necessary repair to restore the area to its original condition in accordance with the terms of the project requirements. If settlement is observed at the surface level, pipe connections should be inspected to ensure soundness.



Section 12.7: Backfilling and Restoration

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Precast Concrete Manhole Installation

Recommendations of **ASTM C1821**
and the **NPCA**

Copies of this standard can be ordered at:

<https://www.astm.org/Standards/C1821.htm>