

PERMACAST® CENTRIFUGALLY CAST CONCRETE PIPE (CCCP)

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PERMACAST® CENTRIFUGALLY CAST CONCRETE PIPE (CCCP)

BY AP/M PERMAFORM®

- 1 **Intent:** It is the intent of this specification to provide minimum standards for materials and methods for waterproofing, sealing, structural reinforcement and corrosion protection of existing concrete storm sewer pipe, concrete sanitary pipe and corrugated steel culvert pipe. The centrifugally cast concrete pipe (CCCP) should extend over the specified length in a continuous structural concrete pipe within a pipe. This specification offers flexibility in design by offering technologies available for repairing the various defects found in these structures.
- 2 **Applicability:** These repair means and methods may be engineered for the depth, diameter, shape, traffic loading, groundwater pressures and condition of each pipe segment.
- 3 **Referenced Standards**
 - 3.1 ASTM C-109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
 - 3.2 ASTM C-157 Modified Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
 - 3.3 ASTM C-293 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
 - 3.4 ASTM C-309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 3.5 ASTM C-403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 3.6 ASTM C-469 Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
 - 3.7 ASTM C-496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
 - 3.8 ASTM C-882 Standard Test Method for Bond Strength of Epoxy Systems Used with Concrete by Slant Shear
 - 3.9 ASTM C-1202 (AASHTO T 277 Equivalent) Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
 - 3.10 ASTM C-666 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
 - 3.11 ASTM D-4783 Standard Test Methods for Resistance of Adhesive Preparations in Container to Attack by Bacteria, Yeast, and Fungi (Modified)
- 4.1 **Safety:** The Local & Federal Safety regulation and Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving entering confined spaces, local and Federal Safety regulation.
- 4.2 **Flow Control:** The Contractor, when required, shall provide for the flow of sewage around the section or sections of main sewer where the rehabilitation is located. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system or similarly suitable method. Pump and bypass lines shall be of adequate capacity to handle the flow.
- 4.3 **TV Inspection:** Inspection of pipelines shall be performed by experienced personnel trained in closed-circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation, and it shall be noted so that these conditions can be corrected. A videotape/CD/DVD and log sheet shall be kept for later reference by the owner.
- 4.4 **Obstruction Removal:** It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, dropped joints, roots, protruding lateral or collapsed pipe that

will prevent installation. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then the Contractor shall notify the owner. The owner may instruct the Contractor to make a point repair excavation to remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's Representative prior to the commencement of the work and shall be considered as a separate pay item.

- 4.5 Infiltration Control: Areas of water seepage shall be sealed off by an approved method. Pools of water shall be removed; however, a dry surface is not required. The Contractor shall patch holes and fill voids in and around existing pipe as directed by the Engineer.
- 4.6 Cleaning: It shall be the responsibility of the Contractor to remove all debris from the sewer. The interior surface shall be cleaned with a high-pressure water-blast sufficient to remove all laitance and loose material and flush debris from the pipe. Rusted portions of corrugated steel pipe should be removed or sand blasted to white metal and coated with a Cor+Gard epoxy rust protector.
- 4.7 A rinse of Con^{mic}Shield[®] shall be applied to sanitary sewer pipe surfaces to ensure the complete kill of acid producing bacterial prior to lining on sanitary sewers.

5 Invert Repair Mortar

5.1 PL-12,000 Invert Repair Mortar

- 5.1.1 The material, PERMACAST[®] PL-12,000, is an ultra high strength, high build, abrasion resistant and corrosion resistant mortar, based on advanced cements and additives including rust inhibitors. When mixed with the appropriate amount of water, a self consolidating free flowing material will develop with high 24 hour compressive strength and adhesion.
- 5.1.2 The hardened material is dense and highly impermeable. The above performance is achieved by a complex formulation of mineral, organic and densifying agents and sophisticated chemical admixtures. Graded quartz sands are used to enhance particle packing and further improve the fluidity and hardened density. The composition also possesses excellent thin-section toughness, high modulus of elasticity and self-bonding.
- 5.1.3 The water content may be adjusted to achieve consistencies ranging from free flowing to plastic. Despite its workability, the mortar has excellent wet adhesion.

5.1.4 Physical Properties

Set Time at 70 °F ASTM C-403	
Initial Set	Approx. 1 hour 30 minutes
Final Set	Approx. 4 hours
Flexural Strength ASTM C-293	
24 hours	min. 800 psi
28 days	min.1200 psi
Compressive Strength ASTM C-109	
24 hours	5,000 psi
28 days	11,500 psi
Split Tensile Strength ASTM C-496	700 psi
Shear Bond ASTM C-882	1,720 psi
Modulus of Elasticity ASTM C-469	
28 days	min. 3.48 ^{10.6}
Freeze Thaw ASTM C-666	300 Cycle Pass
Chloride Permeability ASTM C-1202	<550 Coulombs

6 Centrifugally Cast Concrete Pipe (CCCP)

6.1 PL-8,000 Pipe Lining Mortar

- 6.1.1 The material, PERMACAST® PL-8,000, is a high strength, high build, abrasion resistant and corrosion resistant mortar, based on advanced cements and additives. When mixed with the appropriate amount of water, a paste-like material will develop which may be sprayed, cast or pumped into any area ¼ inch and larger.
- 6.1.2 The hardened liner is dense and highly impermeable. The above performance is achieved by a complex propocity formulation of mineral, organic and densifying agents and sophisticated chemical admixtures including rust inhibitors. Graded quartz sands are used to enhance particle packing and further improve the fluidity and hardened density. The composition also possesses excellent thin-section toughness, high modulus of elasticity and self-bonding. Fibers are added as an aid to casting, for increased cohesion and to enhance flexural strength.
- 6.1.3 The water content may be adjusted to achieve consistencies ranging from plastic to modeling clay. Despite its workability, the mortar has good wet adhesion and does not sag or run after placement. The mortar may be cast against soil, metals, wood, plastic or other normal construction material.

6.1.4 Physical Properties

Set Time at 70 °F ASTM C-403	
Initial Set	Approx. 150 minutes
Final Set	Approx. 240 minutes
Flexural Strength ASTM C-293	
24 hours	min. 600 psi psi
28 days	min.1,080 psi
Compressive Strength ASTM C-109	
24 hours	3,000 psi
28 days	8,000 psi
Split Tensile Strength ASTM C-496	682 psi
Shear Bond ASTM C-882	2,100 psi
Modulus of Elasticity ASTM C-469	
28 days	min. 3.56 ^{10.6}
Freeze Thaw ASTM C-666	300 Cycle Pass

6.2 Corrosion Protection in Sanitary Sewers *Microbiologically Induced Corrosion (MIC)*

- 6.2.1 Con^{mic}Shield® is a liquid additive for concrete and mortars for the prevention of MIC common to concrete pipe, manholes and similar structures in municipal sewer environments. As an additive, it permeates the PERMACAST® mortar during the mixing phase and molecularly bonds to the cement particles to create an environment incompatible to the growth of harmful bacteria.
- 6.2.2 Con^{mic}Shield® becomes an integrated component of the hardened binder. It cannot wash off, delaminate or lose its effectiveness from wear. Scraping or erosion of the concrete surface only serves to expose additional material to the environment that would otherwise foster bacterial growth. As bacterial growth is neutralized, hydrogen sulfide gases released from the raw sewerage cannot be metabolized and converted into sulfuric acid in concentrations sufficient to damage the impregnated concrete and mortar.

- 6.2.3 This material is ideally suited for concrete used to manufacture precast pipe and manholes in municipal sewer environments or wherever Thiobacillus bacteria may cause MIC. Repair mortars with Con^{mic}Shield[®] subjected to concentrations of Thiobacillus bacteria in the laboratory have shown complete neutralization in just 24 hours.
- 6.2.4 CS IDENTIFIER™ color identifier-indicator (CS IDENTIFIER™) shall be spray applied to the interior surface after the initial set to cure and seal the fresh liner and to fortify with Con^{mic}Shield[®]

6.3 Design Criteria

- 6.3.1 Liner thickness shall be applied to the thickness specified by the engineer but no less than 1/2-inch.
- 6.3.2 If additional thickness is desired at any section, simply place the rotating applicator at that section and recommence pumping and retrieval until that area is thickened. Additional layers may be applied at any time after initial set.

6.4 Centrifugally Cast Concrete Pipe (CCCP) Installation

- 6.4.1 Equipment: Mortar mixers, compressors and pumps are standard commercial models. The high-speed, rotating applicator device is used to provide a densely compacted liner of uniform thickness and thorough coverage.

6.4.2 Mixing

- 6.4.2.1 Combine 50 pounds of the packaged dry mix with the specified amount of potable water while mixing with a high-speed shear mixer until proper consistency is obtained. Continue to agitate the mortar to prevent thickening beyond the desired fluidity. The working time is approximately 30 minutes depending upon condition.
- 6.4.2.2 Con^{mic}Shield[®] additive for use only in sanitary sewer systems. The liner material is mixed with just the addition of clean water and Con^{mic}Shield[®] in the prescribed amounts for *Microbiologically Induced Corrosion* (MIC) protection. No other additives shall be used at the site without prior approval.

6.4.3 Application

- 6.4.3.1 Position the rotating casting applicator within the center of the sewer pipe and commence pumping the mixed mortar. As the mortar begins to be centrifugally cast evenly around the interior, retrieve the applicator head at the best speed for applying the thickness that has been selected. If flows are interrupted for any reason, simply arrest the retrieval of the applicator head until flows are restored.
- 6.4.3.2 The retrieval speed can be easily varied to create different thickness as the condition may dictate to provide sufficient strengths. Because of the even application throughout the circumference, thickness may be verified at any point.
- 6.4.3.3 If additional thickness is desired at any section, simply place the rotating applicator at that level and recommence pumping and retrieval until that area is thickened. Built-in bonding agents allow additional layers to be applied at any time.

6.4.3.4 The pressure application from the centrifugal casting of the mortar produces a finely textured surface that requires no additional troweling or finishing

6.4.4 Hot Weather Application (Above 80° F)

6.4.4.1 Do not apply Permacast mortars when ambient and surface temperatures are 100° F or 35° C and above. Shade the material and prepared the surface to keep it cool.

6.4.4.2 To extend working time, mix the material with cool water or ice-cooled water. Be certain the substrate is saturated surface-dry (SSD) before application begins.

6.4.4.3 Proper curing is always required and is particularly important in hot weather. Refer to Section 6.4.6 on curing.

6.4.5 Cold Weather Application (Above 45° F):

6.4.5.1 Do not apply Permacast mortars when ambient temperatures are expected to fall below 45°F or 7° C within 72 hours of placement. Both ambient and substrate temperatures must be at least 45° F or 7° C at the time of placement.

6.4.5.2 Low substrate and ambient temperatures slow down rate of set and strength development. At temperatures below 45° F or 7° C, warm the material, water, and substrate. Properly ventilate the area when heating. Protect the new liner from freezing.

6.4.6 Curing/Finishing: Use an ASTM C309 conforming curing compound such as Cor+Gard Cure N' Seal or CS IDENTIFIER™ as required in the standard.

7 Submittals

7.1 All submittals shall conform to the requirements of the Contract document.

7.2 In addition, the following items may be required of the installer to be submitted to the engineer at the sole discretion of the engineer. This Contract shall not be considered complete until receipt and acceptance of the following:

7.2.1 Reference submittals

7.2.1.1 Contractor certification

7.2.1.2 Material certification

7.2.2 Product data

7.2.2.1 Patching and plugging material

7.2.2.2 Cementitious lining material

7.2.2.3 Cementitious lining with admixture

8 Product Handling

8.1 Special handling is not required for PERMACAST® mortar. Normal precautions for “nuisance dust” shall be observed. Consult Material Safety Data Sheet for details.

8.2 Con^{mic}Shield® is non-toxic and contains no phenols, heavy metals or formaldehyde. It contains an E.P.A. registered antibacterial ingredient (E.P.A. Registration Number (75174-2-47000). It is stable in ultraviolet light and it is leach- resistant. Consult Material Safety Data Sheet for full details.

8.3 The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving entering confined spaces.

9 Quality Assurance and Acceptance

9.1 Two test cubes of the PERMACAST® material shall be taken randomly as directed by the inspector at owner's expense to verify strengths. Thickness can be verified with a wet gage at any random point of the new interior surface. Any areas found to be thinner than minimum shall immediately receive additional material. Visual inspection should verify a leak-free, uniform appearance.

10 Measurement for Payment:

10.1 Payment shall be made at the unit price per linear of finished wall for each prescribed thickness.

***** END OF SECTION *****