

Manufacturing Standards for Precast Concrete Products

March 2009



ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP)



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PRECAST CONCRETE PRODUCT SPECIFICATIONS PRECAST CONCRETE PIPE AND MANHOLES

1.0 INTRODUCTION

CONTENT - This specification covers the requirements for the manufacture of precast concrete pipe, manholes and inlets for use on City of Portland projects.

REFERENCE STANDARDS – Unless noted otherwise, the current version of the references and standards listed in Section 1.3 Standards, Specifications, and Reference Documents will apply. In the event of conflict between the listed standards and these specifications, see Section 1.1 Precedence. Subordinate references within the listed standards will also be used where judged applicable.

1.1 PRECEDENCE

1. In the event of conflicts, generally, but not exclusively the order of precedence will be as follows:
 - a. Addenda
 - b. Project Special Provisions and Plans
 - c. City of Portland – 2007 Standard Construction Specifications, as supplemented and/or modified
 - d. Referenced Standards
2. Manufacturer shall bring any real or perceived discrepancy concerning dimensions, quantities or location between the drawings, details or Specifications to the attention of the Owner's Representative for resolution before beginning that portion of the work. Materials produced without this clarification shall be at the sole risk of the manufacturer.

1.2 SUBMITTALS

Submittals are intended to provide detailed fabrication information to show compliance to specification and design. It is the contractor's responsibility to highlight any proposed variances from specification on submittals. Nothing in the submittal process should be interpreted as changing or overruling the contract documents.

1. Product Data – Submittals shall provide complete product data showing conformance to the project drawings and requirements, including, but not limited to materials used, and conformance to the appropriate standards and specifications.

2. Shop Drawings – Submittals shall include detailed shop drawings, showing design information for each unit, including type and design of concrete (including concrete mix design, or record of prior approval of mix design), size, class and placement of reinforcing steel, as well as supporting design calculations, if appropriate. Shop drawings shall be rendered to scale. A general schedule for production of the units shall be included for the purposes of inspection scheduling.
3. Performance – Upon receipt of submittals marked “NO EXCEPTIONS TAKEN”, or “MAKE CORRECTIONS NOTED” the precast manufacturer will produce the units in accordance with the submittal. It shall be the responsibility of the manufacturer to include the City’s submittal response cover sheet with the fabrication drawings for review during inspection. No City inspection will be made without this documentation on-site. Any units produced before receiving such submittal responses will be subject to rejection. Unless otherwise approved, all units must conform to the submittal and job specifications.

1.3 STANDARDS, SPECIFICATIONS AND REFERENCE DOCUMENTS

1. American Association of State Highway and Transportation Officials (AASHTO)
2. American Concrete Institute (ACI)
 - ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - ACI 224.1R – Causes, Evaluation and Repair of Cracks in Concrete Structures
 - ACI 301 – Structural Concrete Specifications
 - ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete
 - ACI 305 – Hot Weather Concreting
 - ACI 306 – Cold Weather Concreting
 - ACI 309R – Consolidating of Concrete
 - ACI 318 – Building Code Requirements
 - ACI 350 – Code Requirement for Environmental Engineering Concrete Structures
 - ACI 503 – Standard Specification for Repairing Concrete with Epoxy Mortars.
 - ACI 517 – Accelerated Curing at Atmospheric Pressure
 - ACI SP-2 – Manual of Concrete Inspection
3. American Society for Testing and Materials (ASTM)
 - ASTM A 82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - ASTM A 185 – Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

ASTM A 496 – Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

ASTM A 497 – Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

ASTM A 615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 706 – Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

ASTM A 775 – Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

ASTM C 14 – Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe

ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C 33 – Standard Specification for Concrete Aggregates

ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

ASTM C 76 – Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

ASTM C 94 – Standard Specifications for Ready-Mixed Concrete

ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete

ASTM C 150 – Standard Specification for Portland Cement

ASTM C 172 – Standard Practice for Sampling Ready-Mixed Concrete.

ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete.

ASTM C 293 – Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)

ASTM C 361 – Standard Test Method for Reinforced Concrete Low-Head Pressure Pipe

ASTM C 403 – Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

ASTM C 443 – Standard Specifications for Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets

ASTM C 478 – Standard Specifications for Precast Reinforced Concrete Manhole Sections

ASTM C 494 – Standard Specifications for Chemical Admixtures for Concrete.

ASTM C 497 – Standard Test Methods for Concrete Pipe, Manhole Sections and Tile.

ASTM C 618 – Coal Fly Ash or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

ASTM C 655 – Standard Specifications for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe.

ASTM C 822 – Standard Terminology Relating to Concrete Pipe and Related Products.

ASTM C 985 – Standard Specification for Nonreinforced Concrete Specified Strength Culvert, Storm Drain, and Sewer Pipe.

ASTM C 989 – Standard Specification for Ground Granulated Blast Furnace Slag for Use in Concrete and Mortars.

ASTM C 1017 – Chemical Admixtures for Use in Producing Flowing Concrete.

ASTM C 1064 – Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

ASTM C 1077 – Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

ASTM C 1240 – Standard Specification for Silica Fume for Use in Hydraulic-Cement Concrete and Mortar.

ASTM C 1433 – Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.

ASTM C 1602 – Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

ASTM C 1603 – Test Method for Measurement of Solids in Water

ASTM D 1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

ASTM D 2240 – Standard Test Method for Rubber Property – Durometer Hardness

ASTM E 329 – Standard Practice for Use in Evaluation of Testing and Inspection Agencies as Used in Construction.

4. American Welding Society (AWS)

AWS D1.1 – Structural Welding Code – Structural Steel

AWS D1.4 – Structural Welding Code – Reinforcing Steel

5. Concrete Reinforcing Steel Institute (CRSI)

CRSI – Manual of Standard Practice

CRSI – Placing Reinforcing Bars

CRSI – Reinforcement Anchorages and Splices

6. International Code Council (ICC)
International Building Code
ICC – Concrete Manual
7. City of Portland Standard Construction Specifications
8. Oregon Standard Specifications for Construction – Oregon State Department of Transportation/APWA Oregon Chapter
9. United States Department of the Interior, Bureau of Reclamation – Standard Specifications for Reinforced Concrete Pressure Pipe – (M-1) (1991)

ADDITIONAL REFERENCES – In addition to the above Standards and Specifications, the following resources may be referenced as well.

1. American Concrete Pipe Association – ACPA Product Guidelines for Concrete Pipe
2. National Precast Concrete Association – NPCA Guide Specifications for Precast Concrete Products
3. Portland Cement Association – Design and Control of Concrete Mixtures

2.0 QUALITY ASSURANCE AND QUALITY CONTROL

All precast concrete product manufacturers shall have a Quality Assurance and Quality Control (QA/QC) program. Manufacturers have an option to develop their program with the following information as a minimum, or subscribe to an approved accredited certification program. Every approved precast concrete product supplier shall provide two copies of their QA/QC program for City records.

If changes are made to the documented QA/QC plan, the manufacturer shall provide updated documentation that reflects these changes within 15 days from date of implementation. Such documentation shall include, at a minimum, the following information.

1. A detailed plan for record keeping, including:
 - a. Documentation of incoming materials, including, but not limited to; reinforcing steel, cement, aggregates, chemical admixtures, coatings and supplemental materials such as steps, gaskets, cast iron frames and covers and all other material used in the manufacture or production of precast concrete products.
 - b. Records of in-process inspections, including pre-pour and post-pour operations, curing times and temperatures and equipment checks.
 - c. Production records.
 - d. Sampling and testing results.
 - e. In-house testing of products with associated documentation and test records.

2. Designation of individual(s) designated to the Quality Control function for the manufacturer, including qualifications and experience.
3. Individuals performing material sampling and testing shall be certified to take samples and perform tests. Minimum certification requirements are as follows:
 - a. Concrete sampling and testing, including slump, air-content, temperature and compressive strength cylinders: ACI – Concrete Field Testing Technician Grade 1 or equivalent.
 - b. Curing and breaking of compressive strength cylinder: ACI – Concrete Strength Testing Technician.
 - c. Performing mix designs of concrete, controlling daily plant operations: ODOT – Concrete Control Technician.
 - d. When a certified weld is required, the manufacturing process welders will be certified in accordance to the requirements as outlined by the AWS (American Welding Society).
4. The Owner's Representative will be allowed access to all production areas of plant operation where and when materials are being manufactured. A minimum 24-hour notice shall be given to the Owner's Representative before the production of any materials for the City, and every attempt will be made by both parties to facilitate the City's Quality Assurance inspections of the materials. The Owner's Representative will comply with all plant operational and safety requirements including personal protective equipment. The City reserves the right to inspect any and all materials produced for its use, and will reject all material/products manufactured without this inspection, or specific waiver of inspection.

3.0 CURING, HANDLING, STORAGE AND DELIVERY

1. Curing – All precast concrete products shall be cured in a manner to assure highest quality.
 - a. If steam curing is utilized, the manufacturer shall provide adequate steam plant, enclosure, piping and other facilities for curing the concrete materials. The enclosure shall be such that the humidity shall be maintained so as to keep the materials moist at all times. The temperature shall be controlled per ACI 517 and records of curing temperatures shall be maintained as part of the daily inspection process. These records shall reflect initial temperature, rate of increase of temperature, maximum temperature attained and rate of cooling. Maximum temperature of the product shall never exceed 150° F as measured in the concrete mass being cured. Materials that exceed this curing temperature, or for which no temperature records are provided, will be rejected and replaced. Steam curing shall begin not sooner than one hour, nor more than 10 hours after completion of product, and shall be guided by determining the time of initial set, per ASTM C 403. Results of initial set tests shall be provided upon request.

New tests will be run in the event of change of cement supplier, mix design, or as otherwise necessary to maintain a quality product.

- b. Forms on wet-cast concrete shall not be removed until the concrete attains compressive strength equal to 2500 pounds-per-square-inch (psi) based upon field-cured cylinders, cured under conditions which equal the most severe conditions to which the product is exposed.
 - c. Test cylinders for determining “shipping strength” shall be cured with similar methods as the product that they represent. In lieu of actual curing with the product, cylinders may be cured in curing chambers correlated in temperature and humidity with the product conditions.
 - d. In such a case, the correlation shall be verified by use of recording thermometers in the curing chambers, and comparison with the temperature records of the product curing.
 - e. Any precast concrete product which freezes before attaining 500 psi compressive strength will be rejected.
2. Handling – It shall be the responsibility of the precast manufacturer to handle all materials in such a manner as to avoid all damage to product before and during delivery. This damage as defined in Appendix C includes, but is not limited to, structural or spiderweb cracking, chips, spalls, pop-outs or other damage. Minor damage may be repairable, with written approval, but any structural damage to precast product will be cause for rejection and replacement.
 3. Storage – All precast concrete products shall be stored in a manner that will maintain product quality, as well as provide damage protection from yard traffic. All concrete pipe greater than 60-inches in diameter shall be “studded” with a minimum of two each, 4” x 4” wood posts providing vertical support during storage. This requirement shall apply both at the manufacturer’s storage yard and on the jobsite.
 4. Delivery – No precast concrete product shall be delivered to a jobsite or transported from the facility of origin until adequate quality and maturity has been attained, as described in these specifications.
 - All products shall be a minimum age of 7 days.
 - All concrete products shall attain at least the specified design strength.
 - No product shall be delivered without Certification. Any product delivered without acceptable Certification will be subject to rejection.

4.0 MATERIALS

GENERAL – All materials used will be of good quality and will be subject to both appropriate Quality Control inspection by the manufacturer, and Quality Assurance inspection by the City or designated representative. Any materials that do not meet City standards will be rejected.

CONCRETE – Concrete shall be of uniform quality and conform to the City Standard Construction Specifications and the mix designs as submitted for review and approval.

1. Concrete shall conform to ASTM C 94.
2. Cement shall be ASTM C 150, Type I/II, Type-II or Type-V.
3. Fly Ash shall be Class-F in accordance with ASTM C 618, Table 1 and 2.
4. Use of other mineral admixtures, such as Granulated Ground Blast Furnace Slag or Silica Fume will be considered with adequate submission of performance history for mix design evaluation. Such materials shall conform to ASTM C 989 for slag, and ASTM C 1240 for silica fume.
5. Water shall be clean and potable, containing less than 500 parts-per-million (ppm) chlorides and shall conform to ASTM C 1602.
6. Aggregates shall be per ASTM C 33, including gradation requirements.
7. Admixtures shall be supplied by a single manufacturer, and shall be compatible with each other. The listed classes of admixtures shall be the only acceptable materials used.
 - a. Air-entraining admixture, ASTM C 260.
 - b. Water-reducing admixture, ASTM C 494, Type A or D
 - c. High range water-reducing admixture, ASTM C 494, Type F or G, and shall hold minimum slump of 5-inches for the duration of the concrete placement.

REINFORCEMENT – Reinforcement conforming to the following standards shall be steel bars or welded wire fabric, or a combination of both, unless otherwise noted.

1. Reinforcement shall conform to the minimum requirements of the referenced ASTM standards, Specifications and approved submittals.
2. All positioning chairs shall be made of non-corrosive materials.

EMBEDDED ITEMS - Do not use any embedded items without submittal of appropriate product data sheets for review and approval of the City.

REPAIRS – All materials used for making repairs to products must be submitted and approved prior to execution of any repair.

5.0 EXECUTION

REINFORCEMENT – Reinforcement shall be fabricated from approved materials as noted and approved by the Owner's Representative prior to placement of concrete.

1. Reinforcement shall be held firmly in place during concrete placement.

2. Reinforcement cages shall be fabricated either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding where permissible in accordance with AWS standard.
3. Secure cages in place using non-corroding “chairs” or spacers, such as plastic, or epoxy coated steel.
4. Except as noted in Section 8.0 Design, 6a and 6b, reinforcement shall have a minimum cover of one-inch, or greater if shown otherwise in either Appendix A of this document or on approved plans.
5. Tolerance on placement shall be 1/2-inch or as described in the specification, whichever is less. Tolerances are secondary to minimum cover requirements.

CONCRETE – After review of reinforcement and formwork by the Owner’s Representative, place concrete, with the following general considerations.

1. Deposit concrete as close to its final position as practicable. Where necessary to avoid excessive “dropping” of concrete, use a tremie or other placement device as required.
2. All concrete placed within a form shall be homogeneous in nature. Take care to avoid segregation or separation of concrete.
3. Place all dry cast (zero slump) concrete within 45 minutes of the addition of mixing water to the cement. Placement of dry cast concrete shall be continuous. Any interruption in placement of dry cast material longer than 15 minutes will be cause for rejection.
4. Consolidate concrete in such a manner that segregation and separation do not occur. External “Stinger” type vibrators shall be operated in an appropriate manner, as described in the ICC Concrete Manual. Failure to follow these procedures will be cause for rejection. Forms that use form vibrators shall have seams sufficiently tight and close to prevent grout bleeds and leaks. Use a sufficient number of vibrators to ensure uniform consolidation throughout the concrete. The vibrators shall have frequencies and amplitudes sufficient to produce well-consolidated concrete.
5. In cases of extreme temperature conditions, care shall be taken in concrete production and handling.
 - a. Hot weather concreting: During hot weather proper attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation. Follow the recommendations given in ACI 305.

The temperature of the concrete shall not exceed 90° F. at the time of placement.

Assure that water content does not vary from mix design criteria.

Maintain adequate moisture to the fresh concrete to assure proper curing.

- b. Cold weather concreting: During cold weather, proper attention shall be given to ingredients, production methods, handling, placing protection and curing to prevent freezing or other damage to fresh concrete. Follow the recommendations given in ACI 306.

Provide adequate equipment to heat concrete and protect the uncured concrete during freezing and near freezing temperatures. All concrete materials, forms, fillers and the surrounding ground shall be free of frost.

Do not use frozen materials or any materials containing ice.

The temperature of the concrete shall not be below 55° F at the time of placement.

Any precast concrete product which freezes before attaining 500 psi compressive strength will be rejected.

EMBEDDED ITEMS – Place all embedded items at the locations specified in the design documents and submittal shop drawings. Inserts, plates, lifting devices and other embedded items shall be held rigidly in place so that they do not move significantly during the casting operation.

REPAIRS – It is the intent of the City to buy new, undamaged products. Minor damage may be repairable, with written approval of the Owner's Representative, but any significant damage to, or deficiency in, precast products will be cause for rejection and replacement.

It is the responsibility of the manufacturer to develop repair methods and materials, for submittal and review, prior to use. Such submittals must include materials used, preparation methods application methods and curing. Manufacturers can propose such submittals on a case-by-case basis, or as general repair methods suitable to various types of repairable defects. Regardless of the method followed, the manufacturer must:

1. Inform the Owner's Representative of the proposed repair and get authorization to proceed.
2. Provide a minimum 24-hour notice to allow for inspection of the repair process.
3. Allow for inspection of the repair after completion and before product delivery. Any repairs performed without following this process will be rejected.

6.0 REQUIREMENTS FOR PRECAST CONCRETE MANHOLES

STANDARD PRECAST MANHOLE SECTIONS

1. All manhole components, (e.g. sections, bases, cones, reducing slabs and flat top slabs) shall conform to ASTM C 478, City of Portland Standard Details,

“Requirements” as detailed in this section, and Appendix A of this document. Manhole joint designs must be submitted to the Materials Testing Laboratory (MTL) for approval.

2. Top and bottom of all sections shall be parallel and perpendicular to the sides.
3. Precast concrete bases may be used, provided all details of construction are reviewed before shipment. Precast bases shall conform to ASTM C 478, City of Portland Standard Construction Specifications, Special Provisions, and Appendix A of this document.
4. Manhole sections shall require reinforcing steel in the bell, in other than keylock joints.
5. Use only preformed rubber gaskets or mastic sealer for jointing materials unless otherwise approved.

MANHOLE STEPS

1. Steel reinforced polypropylene plastic that conforms to ASTM C 478 and C 497, except that the minimum horizontal pullout load shall be 1500 pounds. The steel shall be grade 60 1/2-inch deformed reinforcing bar conforming to ASTM A 615. The polypropylene shall conform to ASTM D 4101. The polypropylene plastic material surrounding the reinforcing steel bar shall be monolithic encasement, and have a minimum thickness over the steel of 1/16-inch
2. Unless noted otherwise, the manufacturer shall install steel reinforced polypropylene steps in concrete manhole cones and sections before delivery to the jobsite.
3. Installation of steps shall be in accordance with the manufacturer's recommendations and applicable safety standards.
4. All steps within a manhole shall be of the same manufacture and design, type and size. Mixing of unmatched steps within the same manhole is not acceptable. Align steps vertically. Loose steps shall be cause for rejection of that cone or section. Unless specifically allowed in writing by the Owners Representative, field repair or replacement of steps will not be allowed.
5. Use only steps that have current City of Portland approval.

PRECAST SUMPS Conform to requirements shown on the Standard Details and the applicable requirements in the Standard Specifications for precast units. Each unit shall meet the following requirements:

1. Encase each precast perforated sump section with Type III or IV polyethylene netting in accordance with ASTM D 1248, with a minimum one-foot circumferential overlap. All netting shall meet the following engineering design specifications:
 - 1.5% Carbon Black

- Tensile strength of 300 lbs/ft per ASTM D 5034
 - 0.25-inch opening
2. Band the netting in three locations per section with 3/4-inch wide steel bands. Locate the first band above the weep holes, the second at mid-section and the third below the weep holes.
 3. It shall be the responsibility of the in-house Quality Control staff to maintain on file statements of conformance to these specifications for the netting material used. These files shall be available for inspection upon request.

SEDIMENTATION MANHOLES Conform to requirements shown on the Standard Details and the applicable requirements in the Standard Construction Specifications for precast units.

MANHOLE FRAMES AND COVERS See City of Portland Standard Construction Specifications.

TESTING At regular intervals, as stated for each test (or additionally at the request of the Owner's Representative), it shall be the responsibility of the precast manufacturer's Quality Control staff to perform the following tests. The Owner's Representative will select the test materials randomly from the manufacturer's finished product inventory and witness all tests.

1. ASTM C 497 – Flat Slab Test – annually.
2. ASTM C 497 – Absorption Test – per batch plant and per mix design annually.
3. ASTM C 497 – Permeability – per batch plant and per mix design annually.
4. ASTM C 497 – Manhole Step Test – annually, and with the following modifications:
 - Minimum horizontal pull out load shall be 1500 pounds.
 - Holding time for all loads shall be 5 minutes.
 - Steps shall withstand an impact load of 70 pounds at 20° F without cracking or fracturing.
5. Measurement of equipment including, but not limited to, pallets, headers cores and jackets for dimensional conformance – annually.
6. Additionally, it shall be the responsibility of the precast concrete manufacturer's Quality Control staff to perform daily inspections of materials and tests for conformance with these standards. This shall include, but not necessarily be limited to area and placement of reinforcement and concrete compressive strength. Records of these inspections and tests and concrete batching records shall be maintained for 3 years and available for City review.

7.0 REQUIREMENTS FOR NON-REINFORCED CONCRETE PIPE

DESIGN

1. Non-reinforced concrete pipe shall conform to ASTM C 14 or ASTM C 985.
2. Minimum length of pipe shall be 3 1/2-feet.
3. For pipe less than 12-inches in diameter, a “D” ring, roll-on gasketed joint will be allowable.
4. Unless noted otherwise, all joints must be City of Portland approved joints, per Concrete Pipe Joint Details, Figures 1 through 4 in Appendix B.

PRODUCTION

For purposes of testing, a “batch” will consist of 250 consecutively produced pieces or any portion thereof, covering not more than three production days within the same week.

QUALITY CONTROL

It shall be the responsibility of the manufacturers’ Quality Control staff to perform the requisite inspections and tests as outlined in ASTM C 14, with the following modifications.

1. Minimum required concrete strength shall be 4000 psi at date of shipping.
2. Perform three edge bearing test on a “per batch” basis, as defined in Section 7.0 Production, with the following procedure modifications:

Hold the ultimate load for 15 seconds before releasing. Failure of the pipe before expiration of the time will be considered failure of the test. Number of retests to certify the batch shall be per ASTM C 14.

The Owner’s Representative will periodically require that pipe be tested up to three times annually to determine not only conformance with the minimum required strength, but actual ultimate strength, as defined in ASTM C 822.

Perform additional tests for conformance to absorption and permeability on a similar basis as described for manholes in Section 6.0 Requirements for Precast Concrete Manholes.

8.0 REQUIREMENTS FOR REINFORCED CONCRETE PIPE

DESIGN

1. Reinforced concrete pipe shall conform to ASTM C 76 or where specifically required or allowed, ASTM C 361 or ASTM C 655, except as modified.

2. No elliptical or other “orientational” cages shall be permitted. All pipe shall be manufactured with one or two circular cages.
3. Calculation of area of reinforcement shall be based upon nominal wire size. Deformed wire shall be measured by weight; smooth wire may be measured by diameter.
4. Minimum length of pipe shall be 7 feet; maximum length of pipe shall be 12 feet unless otherwise approved.
5. Tolerances for dimensions of pipe shall be as noted in ASTM C 76, except as follows:
 - a. Placement shall be as noted in Section 5.0 EXECUTION.
 - b. The lengths of two opposite sides of pipe shall not vary by more than the lesser of the ASTM C 76 standards or 50% of the maximum allowable installed joint gap for the particular pipe being manufactured. Pipe exceeding this standard will be rejected.
6. All pipes greater than 24-inches in diameter shall have both longitudinal and circumferential reinforcement in both the bell and the spigot.
 - a. Reinforcement of the bell shall be equal to or greater than the reinforcement in the outer cage. If a separate bell wire is used, it shall be a minimum of 2 times the joint depth, except where limited by minimum cover requirements. If necessary, an extra “round off” wrap shall be used to insure that the final wrap of reinforcement is parallel to the end plane of the bell. End cover over the last circumferential wrap shall be 1-inch, +/- 1/2-inch.
 - b. Reinforcement in the spigot shall be equal to or greater than the reinforcement required for the inner cage. If a separate spigot wire is used, it shall extend at least 8-inches past the shoulder of the spigot. If necessary, an extra “round-off” wrap shall be used to insure that the final wrap of reinforcement is parallel to the end plane of the spigot. End cover over the last circumferential wrap shall be 1-inch, +/- 1/2-inch.
 - c. Any exposed circumferential reinforcement shall be cause for rejection of the pipe. No repair on such pipe will be acceptable.

PRODUCTION

1. For purposes of testing, a “batch” will consist of 100 consecutively produced pieces or any portion thereof, covering not more than one continuous work week (Monday through Saturday), except that for pipe 60-inches in diameter or greater, the “work week” requirement is waived. Continuous production will be defined as:
 - a. Pipe of the same size, design and configuration

- b. Pipe made without a break of greater than three days
 - c. Pipe made without changes in production setup (such as changing to a different machine setup for a one-day run of a different size).
2. Manufacturing of special “test pieces” will not be allowed. All test samples will be selected from stock available for delivery.

QUALITY CONTROL

1. It will be the responsibility of the precast concrete manufacturer to submit for review and approval a Quality Control Manual, detailing processes and procedures to be used by the manufacturer to meet the minimum requirements as spelled out in this specification and the related standards.
2. It shall be the responsibility of the manufacturers' Quality Control department to perform the requisite inspections and tests as outlined in ASTM C 76, C 361, and/or C 655 as appropriate, with the following modification.

- a. Perform 3-edge bearing testing on a “per batch” basis as previously defined, except that:

Load shall be applied to the pipe at a rate no greater than that described in ASTM C 497 up to the load defined for the 0.01-inch crack. Upon request, this load shall be “held” at any point in the loading process while the Owners Representative thoroughly checks the pipe to determine if any cracks of 0.01-inch or greater have developed.

Any pipe exhibiting a crack of 0.01-inch or greater over a distance of one foot when checked with the 0.01-inch feeler gauge at a minimum of four separate locations in that foot at the point of that defined load will be considered to have failed the test.

Additional load shall be applied to the pipe at a rate no greater than allowed in ASTM C 497, until the load required for the minimum “ultimate” strength is obtained. This load shall be held for a minimum of one minute.

Any pipe not able to maintain the defined minimum ultimate load for the requisite one-minute minimum will be considered to have failed the test.

Periodically, the pipe will be required to be tested to whatever load necessary to determine the actual 0.01-inch capability of the pipe (if greater than the minimum test load), and the actual ultimate load for the pipe being tested. Option of testing may be exercised up to 3 times annually per size and class of pipe.

The reinforcement in the pipe may be required to be exposed for examination, upon request.

In the event of failed tests, the number of pipe for retest will be per ASTM C 76, unless otherwise noted.

- b. Perform testing for conformance to absorption requirements as defined in section 6.0 of this document.
- c. Perform hydrostatic testing on reinforced concrete pipe as defined in ASTM C 361, with an assumed head of 25 feet, except include the test for “maximum deflected position” as described in ASTM C 443. Determine acceptance per ASTM C 361. Time of test shall be minimum 20 minutes, with an additional 5 minutes per inch of wall thickness (or fraction thereof) over 4 inches.

For example, a 48-inch “B-wall” pipe shall have a test time of 25 minutes, while a 72-inch “C-wall” pipe shall have a test time of 40 minutes. These tests shall be performed bi-annually on all pipe sizes produced.

- d. Perform joint shear testing, per ASTM C 497. These tests shall be performed every two years on all pipe sizes up to and including 42-inch diameter, and annually on all pipe sizes 48-inches in diameter and greater. Pipe pieces tested for joint shear loading will be unacceptable.
 - e. Perform Joint Proof Testing as defined in these standards at 8-year intervals on all pipe sizes manufactured. Pipe pieces tested for shear load will be unacceptable.
 - f. Perform gasket tests for durometer hardness, length, height, volume and splice integrity on incoming batches of gaskets. Test frequency shall be as defined in ACPA Product Guidelines for Concrete Pipe, use Gasket Quality Report Form in Appendix B.
 - g. Perform measurements of physical dimensions of pipe for conformation to tolerances.
 - h. Perform measurements of production tooling annually.
 - i. Maintain records of all tests and inspections for review.
- 3. The manufacturer’s Quality Control Representative will be present during production operations.

9.0 REQUIREMENTS FOR CONCRETE PIPE JOINTS

- 1. Unless noted otherwise, use rubber gaskets for bell and spigot pipe conforming to ASTM C 443. Do not coat pipe internally or externally with any substance of any type in an attempt to improve its performance when air or hydrostatically tested.
- 2. Unless noted otherwise, all joints must be approved, per Concrete Pipe Joint Details, Figures 1 through 4 in Appendix B.
- 3. Joint type R-3 (commonly called profile gasket joints) per Figures 1 and 2 in Appendix B must be approved before they are used.

4. The surfaces of the bell and spigot in contact with the gasket and adjacent surfaces that may come in contact with the gasket within the specified joint movement range shall be free from defects.
5. Unless otherwise noted, the inside surface of the bell adjacent to the bell face shall be flared to facilitate joining the pipe sections without damaging or displacing the gasket.
6. The details in Appendix B are for all reinforced concrete pipe. Any deviation from this standard will be subject to a submittal and review process as directed.
 - a. General – Form and manufacture the joint assemblies so that when the pipes are drawn together in the trenches, the pipe forms a continuous watertight conduit with a smooth and uniform interior surface, and provides for slight movement of any pipe in the pipeline due to expansion, contraction, settlement or lateral displacement. The rubber gasket shall be the sole element of the joint depended upon to provide water tightness. The ends of the pipe shall be in planes at right angles to the longitudinal centerline of the pipe, except where bevel end pipe for deflections up to 5-degrees is specified for bends. Joint faces shall be finished to regular smooth surfaces and shall have all surface points within 1/4-inch of a theoretical plane taken normal to the pipe axis.
 - b. Design – The joint design shall be joint type R-4, per Figures 3 and 4 in Appendix B. The shape and dimensions of the joint shall be such as to provide the following minimum requirements:

The rubber gaskets shall be solid gaskets of circular cross section. The gasket shall be confined in a groove in the spigot end of the pipe so that movement of the pipe or hydrostatic pressure cannot displace the gasket. When the joint is assembled, the gasket shall be compressed to form a watertight seal.

The volume of the annular space provided for the gasket, with the engaged joint at normal joint closure in concentric position, shall not be less than the design volume of the gasket given on the Joint Data Form (Appendix B). The cross sectional area of the annular space shall be calculated for the minimum bell diameter, maximum spigot diameter, minimum width of groove at surface of spigot and minimum depth of groove. The volume of the annular space shall be calculated considering the centroid of the cross-sectional area to be at the midpoint between the inside bell surface and the surface of the groove on which the gasket is seated at the centerline of the groove.

If the design volume of the gasket given on the Joint Data Form (Appendix B), is less than 75% of the volume of the annular space in which the gasket is to be contained with the engaged joint at normal joint closure in concentric position, the gasket shall not be stretched more than 20% of its unstretched length when seated on the spigot or not more than 30% if the design volume of the annular space is 75% or more of the volume of the annular space.

For determining the volume of the annular space, the cross-sectional area of the annular space shall be calculated for average bell diameter, average spigot diameter, average width of groove at surface of the spigot and average depth of groove. The volume of the annular space shall be calculated considering the centroid of the cross-sectional area to be at the midpoint between the inside bell surface and the surface of the groove on which the gasket is seated at the centerline of the groove.

It is further specified that when the design volume of the gasket is less than 75% of the volume of the annular space, as calculated above, the gasket shall be of such diameter that when the outer surface of the spigot and inner surface of the bell come into contact at some point in their periphery, the deformation in the gasket shall not exceed 40% at the point of contact nor be less than 15% at any point. If the design volume of the gasket is 75% or more of the volume of the annular space, the deformation of the gasket, as prescribed above, shall not exceed 50% nor be less than 15%.

When determining the maximum percent deformation of the gasket, the maximum groove width, the minimum depth of groove, and the stretched gasket diameter shall be used and calculations made at the centerline of the groove.

When determining the minimum percent deformation of the gasket, the minimum groove width, the maximum bell diameter, the minimum spigot diameter, the maximum depth of groove and the stretched gasket diameter will be used and calculations made at the centerline of the groove. For gasket deformation calculations the stretched gasket diameter shall be obtained by the following calculation: Divide the design diameter of - gasket by the square root of $(1 + x)$. ("x" equals the design percent stretch divided by 100).

Each gasket shall be manufactured to provide the design volume of rubber required by the joint design used and within a tolerance of $\pm 3\%$ for gaskets up to and including 1/2-inch diameter and $\pm 1\%$ for gaskets of 1 inch diameter or larger. The allowable percentage tolerance shall vary linearly between $\pm 3\%$ and $\pm 1\%$ for gasket diameters between 1/2-inch and 1-inch.

The tolerance permitted in the construction of the joint shall conform to those stated for the joint design on the approved Joint Data Form (Appendix B).

The taper on all surfaces on the bells and/or the spigots on which the rubber gaskets may bear during closure of the joint and at any degree of partial closure, except within the gasket groove, shall not exceed 2 degrees.

The Owners Representative will utilize the joint data to determine an acceptable joint gap for the particular joint design submitted. The gap will be established by subtracting the settlement allowance shown in Table 1, from the total distance over which the joint may be pulled while meeting the provisions of this specification, or else will be equal to 1-1/2-inches, whichever is the smaller. This determination will be known as the Maximum Allowable Installed Joint Gap.

Installations which exceed this value will be considered as non-conforming. Utilization of a portion of the "settlement allowance" will not be allowed.

TABLE 1
SETTLEMENT ALLOWANCE

PIPE INSIDE DIAMETER (INCHES)	SETTLEMENT ALLOWANCE (INCHES)
27 and 30	3/8
36	1/2
42	1/2
48	5/8
54	5/8
60	3/4
66	3/4
72	7/8
84 AND GREATER	1

- c. As an alternative to the above calculation, the manufacturer shall have the option to propose the following joint performance test:

Join two pipe lengths at a suggested joint gap determined by the manufacturer. Support the pipes to be tested only under the bell end. Plug the ends and bulkhead to prevent movement.

Fill the pipe with water.

Apply a shear load equal to an additional 4000 pounds per foot diameter of the pipe to the spigot end, one-inch from the joint.

Bring the internal pressure to 13 psi and hold it for 20 minutes. Any leakage from the joint or surrounding area shall be defined as failure to perform at that joint gap.

If the joint leaks at a given gap, repeat the procedure at a smaller joint gap. Minimum increments of gap shall be 1/8-inch.

Repeat this process until 5 joints with the same joint gap are tested without leakage.

Maximum installed joint gap shall be defined as the maximum gap at which no leakage occurs as determined by this test, minus the value provided in Table 1.

QUALITY CONTROL

1. All pipe and joint systems for used on projects must have a current Letter of Approval from the City. In order to certify a pipe and joint system, the pipe must

satisfy the following Joint Proof Test. The intent of this requirement is to pre-qualify joint system components that meet the water tightness capability of the joint system. This Proof Test shall apply to all concrete pipes that are to be used in the City. Joints shall meet the requirements of yard testing as specified below. The pipes shall be subject to the three proof tests below. All test pipe and gaskets shall be previously unused.

- a. Pipe in straight alignment - Assemble a total of five test joints according to the manufacturer's recommendation from stock selected by the Owner's Representative. Support the pipe at both ends, and plug bulkhead to prevent movement, with the joint fully "homed". The pipe shall then be filled with water, and allowed to stand for 24 hours. The pipe will then be inspected for evidence of tension cracking at the bell. Such cracks, if found, shall be considered failure of the test. If none are found, then the system shall be pressurized to 13 psi and held for 20 minutes. Leakage (from the joint or pipe wall) that collects and drips will be considered failure of the test.

The pipe will then be allowed to stand an additional 24 hours filled with water, and again inspected for tension cracks in the bell. Such cracks, if found shall be considered failure of the test.

- b. Pipe in maximum deflected position - A total of five test joints shall be assembled from stock selected by the Owner's Representative, with each joint deflected a minimum of 1/2-inch. The pipe shall be supported at both ends, and shall be bulkheaded to prevent movement. The pipe shall then be filled with water, and pressurized to 10 psi and held for 20 minutes. Leakage from the joint or pipe wall which collects and runs or drips will be considered failure of the test.
 - c. Joints under differential load - A total of five test joints shall be assembled from stock selected by the Owner's Representative. These test pipes shall be assembled so that one pipe is suspended freely, bearing only on the joints, with the test joint deflected 1/2-inch. Bulkhead the pipe against movement and fill with water. Provide a shear load equal to an additional 250 pounds per inch diameter immediately adjacent to the deflected joint. Pressurize to 10 psi and hold for 20 minutes. Leakage from the joint or pipe wall which collects and drips shall be considered failure of the test. Following the test, examine the bell for signs of tension cracking. Presence of such cracks will be considered failure of the test.
 - d. Perform Joint Proof Testing as defined in these standards at 5-year intervals on all pipe sizes manufactured. Pipe tested for shear load will be unacceptable for delivery to any jobsite.
2. Perform joint shear testing, per ASTM C 497. These tests shall be performed bi-annually on all pipe sizes up to and including 42-inch diameter, and annually on all pipe sizes 48-inches in diameter and greater. Pipe tested for joint shear loading will be unacceptable for delivery to any jobsite.

3. Perform gasket tests for durometer hardness, length, height, volume and splice integrity on incoming batches of gaskets for City jobs. Test frequency shall be as defined in ACPA Product Guidelines for Concrete Pipe. Use Gasket Quality Report Form in Appendix B.

APPENDIX A – Standard Drawings, Top Slab Plan, Section, Size & Reinforcement Schedules

The following are Standard Details that cover Precast Concrete Products:

Top Slab Plan, Section and Reinforcement Drawings:

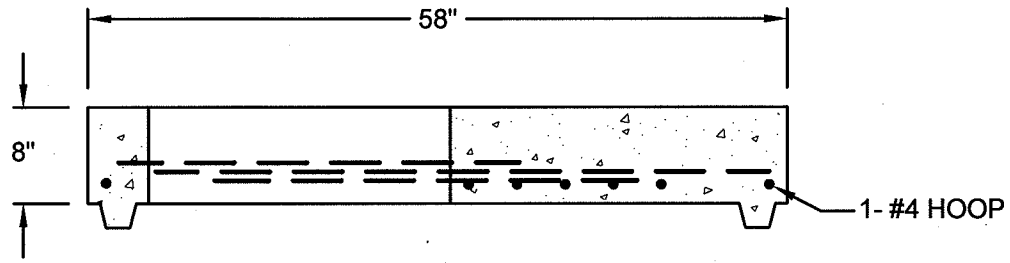
No. P-140	Top Slab “A”
No. P-141	Top Slab “B”
No. P-142	Top Slab “C”
No. P-143	Top Slab “D”
No. P-144	Top Slab “E” (Reducing Slab for 60” dia.)
No. P-145	Top Slab “E” (Reducing Slab for 72”-144” dia.)

Size and Reinforcement Schedules:

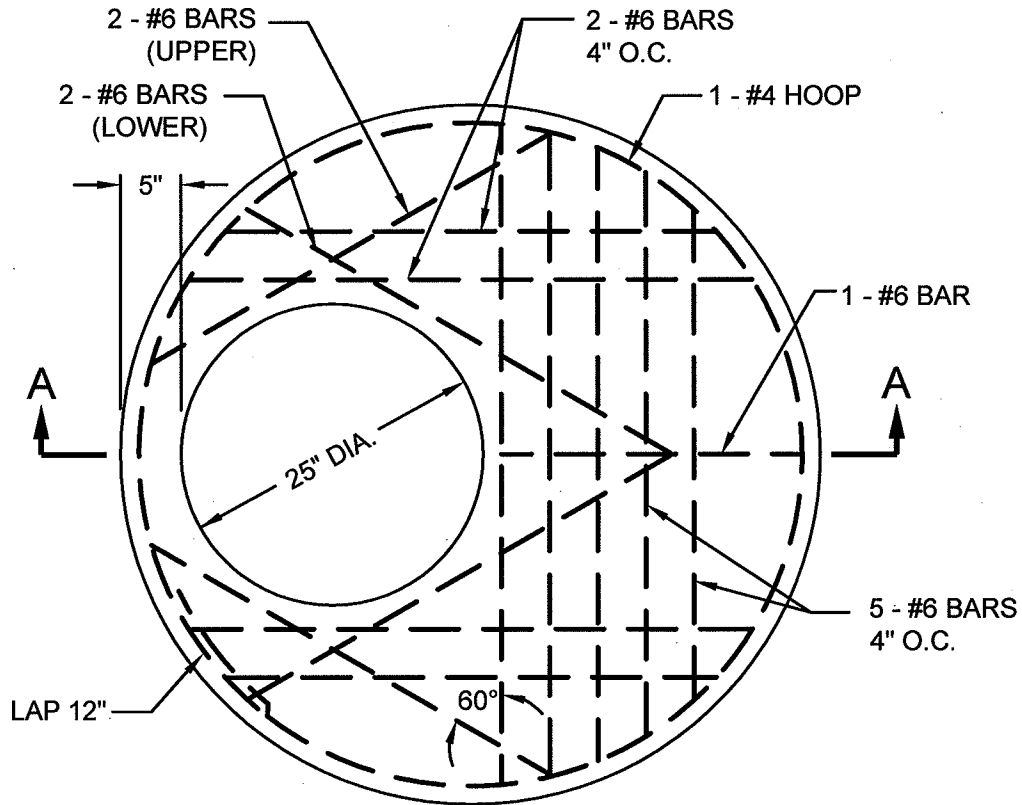
No. P-146	Longitudinal Section (60” dia. – 96” dia.)
No. P-147	Longitudinal Section (108” dia. – 144” dia.)
No. P-148	Top Slabs “A” through “D”
No. P-149	Top Slab “E” and Base Slab

Standard Drawing / Detail Number and Title:

No. P-150	PRECAST CONCRETE MANHOLE
No. P-151	MANHOLE CAST-IN-PLACE BASE & PRECAST BASE SLAB
No. P-152	TOP SLABS FOR PRECAST MANHOLES
No. P-160	PRECAST SUMP
No. P-161	SEDIMENTATION MANHOLE WITH HOOD
No. P-162	SEDIMENTATION MANHOLE WITH BAFFLE
No. P-163	SEDIMENTATION MANHOLE WITH ELBOW
No. P-164	SAMPLING MANHOLE
No. P-168	STEP FOR PRECAST MANHOLE



SECTION A-A



PLAN

NOTES:

- CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
- REINFORCEMENT SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI (GRADE 60).
- LAP SPLICES SHALL BE A MINIMUM OF 24 BAR DIAMETERS IN LENGTH UNLESS OTHERWISE NOTED.
- ALL REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1½" CLEARANCE TO OUTSIDE SURFACES, INCLUDING TO THE INSIDE FACE AT OPENING.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Top Slab "A" for Precast Manhole



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

William F. Ry...
Chief Engineer

Calc. Book No.

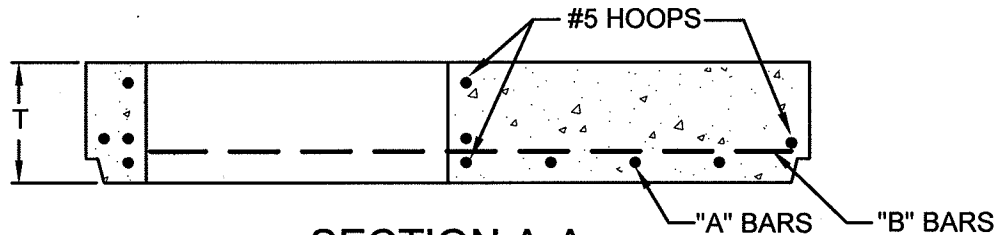
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Effective Date

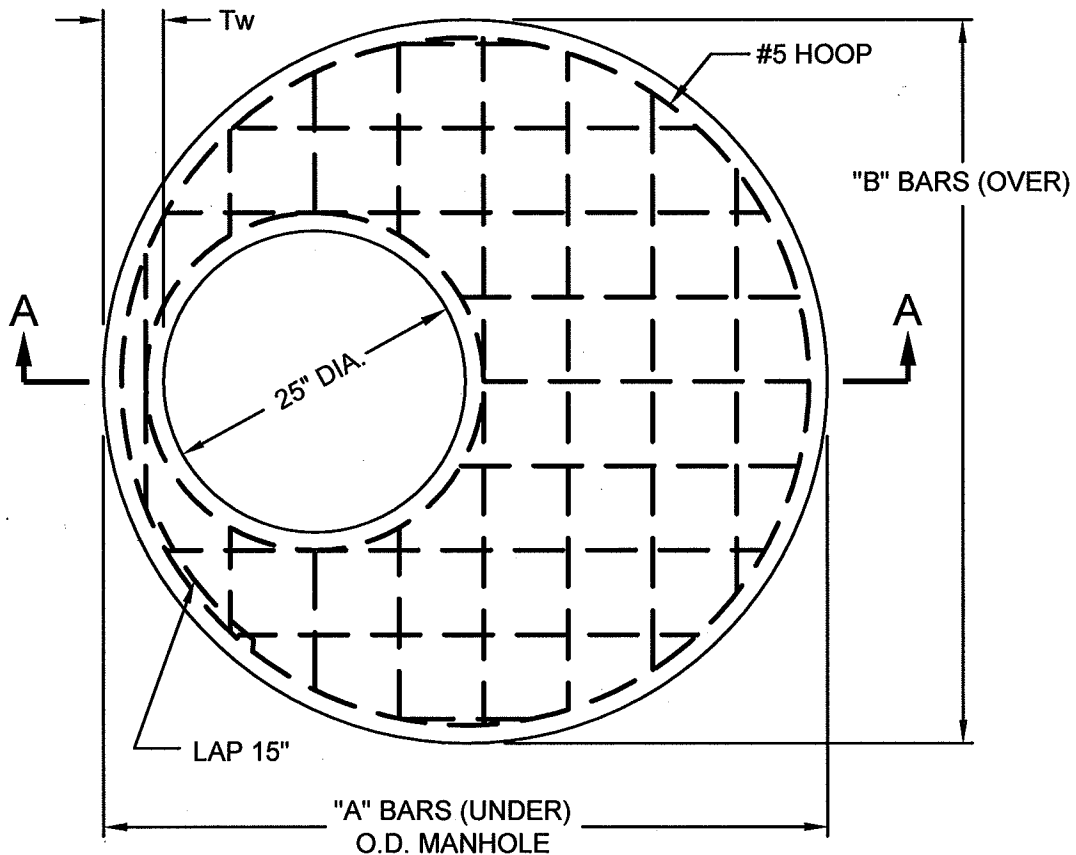
01-01-09

Standard Drawing No.

P-140



SECTION A-A



PLAN

NOTES:

- CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
- REINFORCEMENT SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI (GRADE 60).
- LAP SPLICES SHALL BE A MINIMUM OF 24 BAR DIAMETERS IN LENGTH UNLESS OTHERWISE NOTED.
- ALL REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1½" CLEARANCE TO OUTSIDE SURFACES, INCLUDING TO THE INSIDE FACE AT OPENING.
- OMIT BARS 6" OR LESS IN LENGTH. PROVIDE 6" TO 14" BARS WITH A 90° 4" HOOK, EACH END. HOOK SHALL BEND UPWARD TOWARD TOP OF SLAB.
- LOWER HOOP AROUND OPENING SHALL BE TIED TO TOP OF BOTTOM MAT REINFORCEMENT. UPPER HOOP SHALL BE LOCATED 1½" CLEAR OF TOP SURFACE OF SLAB.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Top Slab "B" for Precast Manhole



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Chief Engineer

Calc. Book No.

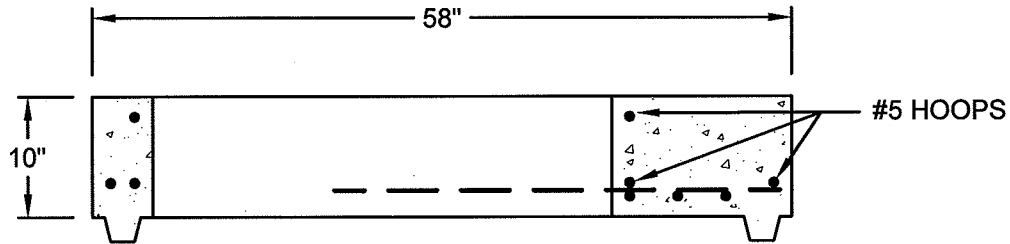
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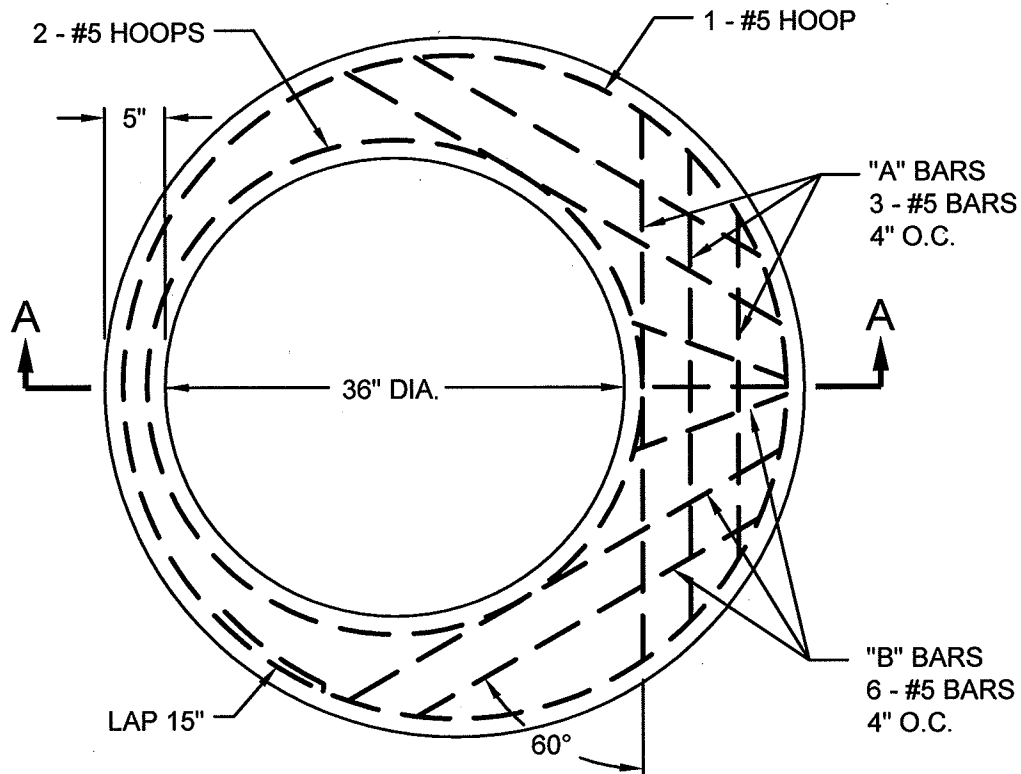
01-01-09

Standard Drawing No.

P-141



SECTION A-A



PLAN

NOTES:

- CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
- REINFORCEMENT SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI (GRADE 60).
- LAP SPLICES SHALL BE A MINIMUM OF 24 BAR DIAMETERS IN LENGTH UNLESS OTHERWISE NOTED.
- ALL REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1½" CLEARANCE TO OUTSIDE SURFACES, INCLUDING TO THE INSIDE FACE AT OPENING.
- LOWER HOOP AROUND OPENING SHALL BE TIED TO TOP OF BOTTOM MAT REINFORCEMENT. UPPER HOOP SHALL BE LOCATED 1½" CLEAR OF TOP SURFACE OF SLAB.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Top Slab "C" for Precast Manhole



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

John F. O'Connell
Chief Engineer

Calc. Book No.

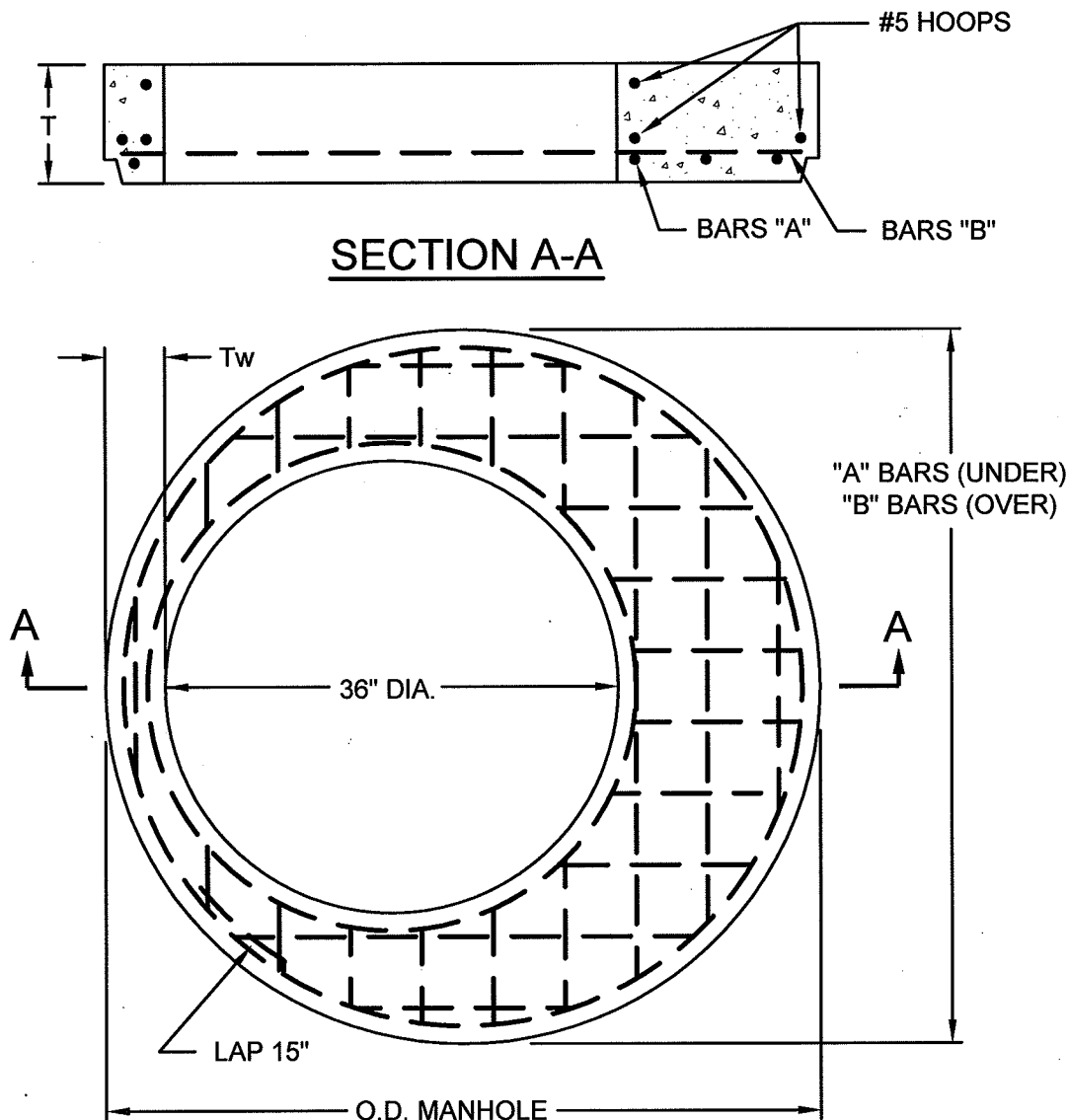
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Effective Date

01-01-09

Standard Drawing No.

P-142



NOTES:

- CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
- REINFORCEMENT SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI (GRADE 60).
- LAP SPLICES SHALL BE A MINIMUM OF 24 BAR DIAMETERS IN LENGTH UNLESS OTHERWISE NOTED.
- ALL REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1½" CLEARANCE TO OUTSIDE SURFACES, INCLUDING TO THE INSIDE FACE AT OPENING.
- OMIT BARS 6" OR LESS IN LENGTH. PROVIDE 6" TO 14" BARS WITH A 90° 4" HOOK EACH END. HOOK SHALL BEND UPWARD TOWARD TOP OF SLAB.
- ADD A TEMPERATURE REINFORCEMENT MAT OF #4 BARS @ 12" E.W., 1½" CLEAR OF TOP SURFACE, ON ALL TOP SLABS GREATER THAN 12" IN THICKNESS.
- LOWER HOOP AROUND OPENING SHALL BE TIED TO TOP OF BOTTOM MAT REINFORCEMENT. UPPER HOOP SHALL BE LOCATED 1½" CLEAR OF TOP SURFACE OF SLAB. IF TEMPERATURE REINFORCEMENT IS REQUIRED, UPPER HOOP SHALL BE TIED UNDERNEATH TOP MAT REINFORCEMENT.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Top Slab "D" for Precast Manhole



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

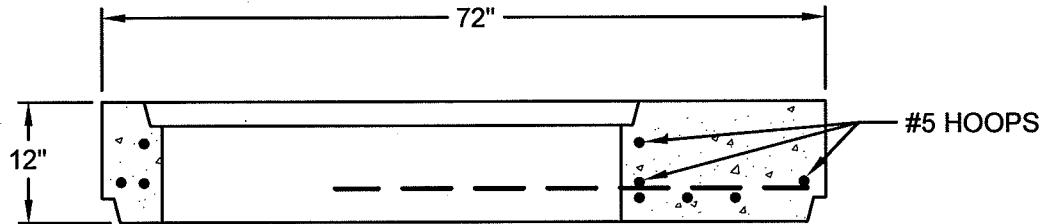
Walter F. Ryan
Chief Engineer

Calc. Book No.
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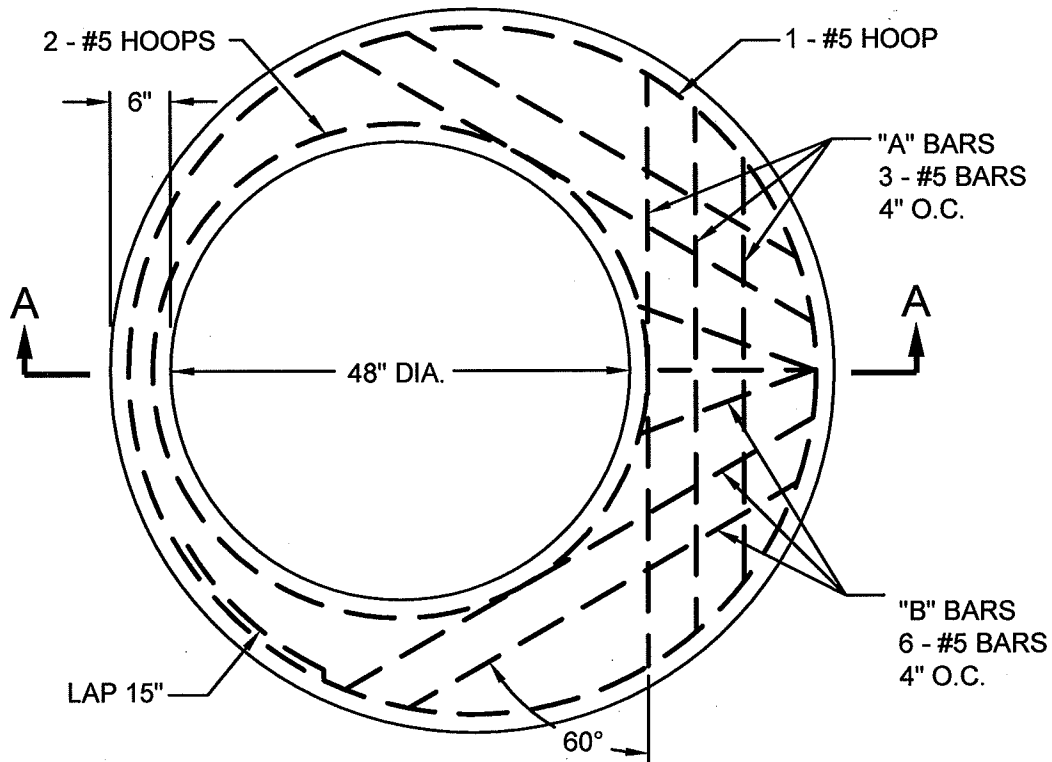
Effective Date
01-01-09

Standard Drawing No.

P-143



SECTION A-A



PLAN

NOTES:

- CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
- REINFORCEMENT SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI (GRADE 60).
- LAP SPLICES SHALL BE A MINIMUM OF 24 BAR DIAMETERS IN LENGTH UNLESS OTHERWISE NOTED.
- ALL REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1½" CLEARANCE TO OUTSIDE SURFACES, INCLUDING TO THE INSIDE FACE AT OPENING.
- UPPER HOOP AROUND OPENING MAY BE LOCATED A MINIMUM OF 1" BELOW BOTTOM FACE OF RISER JOINT, OR A LARGER HOOP MAY BE LOCATED A MINIMUM OF 1½" CLEAR OF OUTSIDE FACE OF RISER JOINT AND 1½" CLEAR OF TOP OF SLAB.
- LOWER HOOP AROUND OPENING SHALL BE TIED TO TOP OF BOTTOM MAT REINFORCEMENT.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Top Slab "E" (Reducing Slab) for Precast Manhole (60" Dia.)



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Chief Engineer

Calc. Book No.

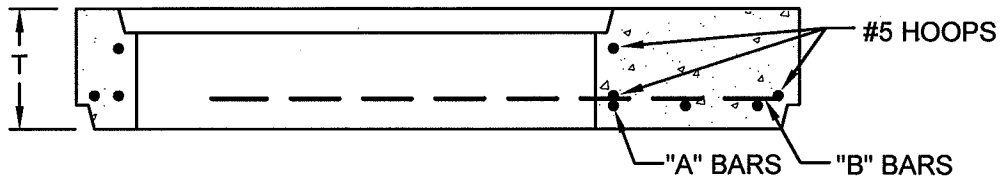
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Effective Date

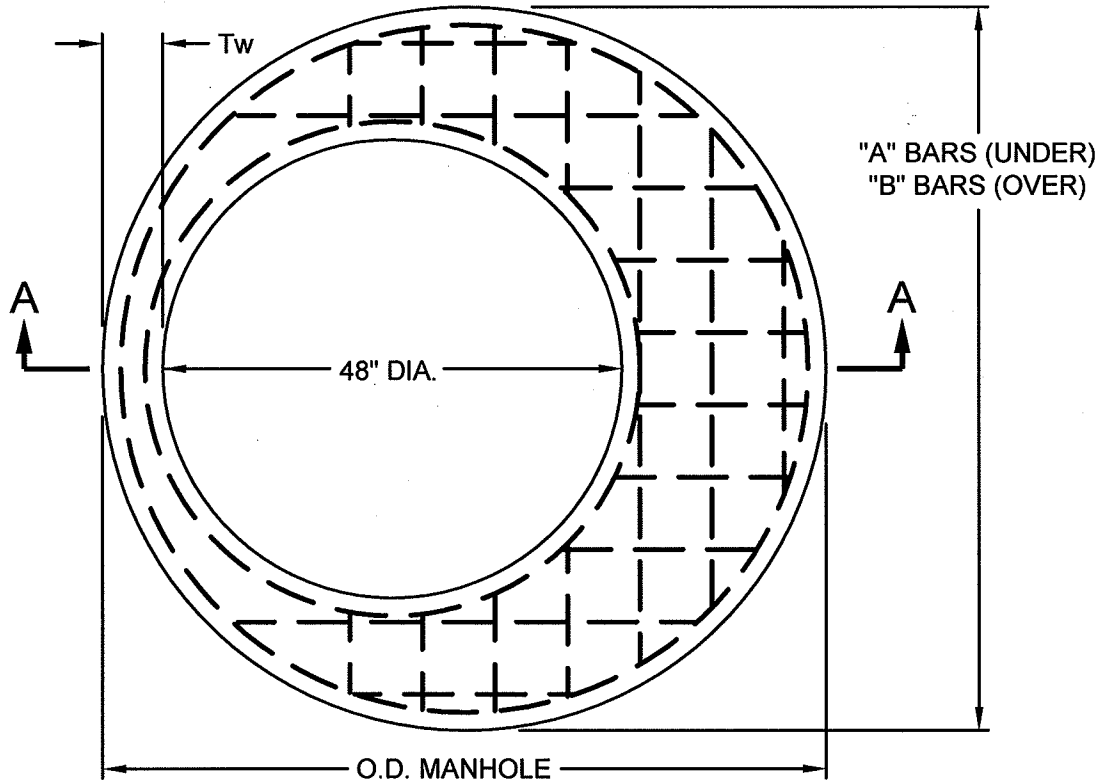
01-01-09

Standard Drawing No.

P-144



SECTION A-A



PLAN

NOTES:

- CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
- REINFORCEMENT SHALL HAVE A MINIMUM YIELD STRENGTH OF 60,000 PSI (GRADE 60).
- LAP SPLICES SHALL BE A MINIMUM OF 24 BAR DIAMETERS IN LENGTH UNLESS OTHERWISE NOTED.
- OMIT BARS 6" OR LESS IN LENGTH. PROVIDE 6" TO 14" BARS WITH A 90° 4" HOOK EACH END. HOOK SHALL BEND UPWARD TOWARD TOP OF SLAB.
- ADD A TEMPERATURE REINFORCEMENT MAT OF #4 BARS @ 12" E.W., 1½" CLEAR OF TOP SURFACE, ON ALL TOP SLABS GREATER THAN 12" IN THICKNESS.
- ALL REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1½" CLEARANCE TO OUTSIDE SURFACES, INCLUDING TO THE INSIDE FACE AT OPENING.
- REINFORCING HOOPS AND BARS SHALL HAVE A MINIMUM 1" CLEARANCE TO BOTTOM FACE AND 1½" CLEARANCE TO OUTSIDE FACE OF 48" RISER JOINT.
- UPPER HOOP AROUND OPENING MAY BE LOCATED A MINIMUM OF 1" BELOW BOTTOM FACE OF RISER JOINT, OR A LARGER HOOP MAY BE LOCATED A MINIMUM OF 1½" CLEAR OF OUTSIDE FACE OF RISER JOINT AND 1½" CLEAR OF TOP OF SLAB. IF TEMPERATURE REINFORCEMENT IS REQUIRED, HOOP SHALL BE TIED UNDERNEATH TOP MAT REINFORCEMENT.
- LOWER HOOP AROUND OPENING SHALL BE TIED TO TOP OF BOTTOM MAT REINFORCEMENT.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Top Slab "E" (Reducing Slab) for Precast Manhole (72"-144" Dia.)



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Chief Engineer

Calc. Book No.

001

Effective Date

01-01-09

Standard Drawing No.

P-145

60-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 5.0"			Tw = 6.0"			Tw = 6.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.13	0.11	0.16	0.13	0.09	0.13	0.15	0.08	0.13
	15 - 30	0.21	0.16	0.33	0.18	0.18	0.26	0.21	0.15	0.23
TYPE 2	0 - 15	0.14	0.11	0.23	0.15	0.09	0.15	0.15	0.08	0.17
	15 - 30	0.31	0.16	0.51	0.24	0.18	0.21	0.21	0.15	0.34

"C" Bars - 1 No 4 hoop, 2" clear of top of manhole barrel section, required for less than 2'-0" clear between blockout and top of full thickness wall.

72-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 6.0"			Tw = 7.0"			Tw = 7.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.18	0.13	0.22	0.15	0.11	0.19	0.17	0.10	0.17
	15 - 30	0.28	0.20	0.48	0.23	0.22	0.39	0.24	0.20	0.35
TYPE 2	0 - 15	0.18	0.13	0.29	0.19	0.11	0.24	0.17	0.10	0.21
	15 - 30	0.37	0.20	0.65	0.30	0.22	0.52	0.26	0.20	0.46

"C" Bars - 2 No 5 hoops 2" clear of top of manhole barrel section.
2 No 4 hoops 2" clear over pipe blockouts } Required for less than 2'-0" clearance between blockout and top of full thickness wall.

84-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 7.0"			Tw = 8.0"			Tw = 8.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.22	0.14	0.29	0.19	0.12	0.25	0.19	0.11	0.22
	15 - 30	0.36	0.22	0.64	0.30	0.24	0.53	0.28	0.22	0.48
TYPE 2	0 - 15	0.23	0.14	0.39	0.25	0.12	0.34	0.23	0.11	0.30
	15 - 30	0.43	0.22	0.79	0.36	0.24	0.65	0.32	0.22	0.58

"C" Bars - 2 No 5 hoops 2" clear of top of manhole barrel section.
2 No 4 hoops 2" clear over pipe blockouts } Required for less than 2'-0" clearance between blockout and top of full thickness wall.

96-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 8.0"			Tw = 9.0"			Tw = 9.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.25	0.15	0.33	0.22	0.13	0.29	0.21	0.12	0.26
	15 - 30	0.40	0.25	0.74	0.34	0.22	0.63	0.32	0.20	0.57
TYPE 2	0 - 15	0.25	0.15	0.37	0.24	0.13	0.32	0.22	0.12	0.30
	15 - 30	0.46	0.25	0.87	0.40	0.22	0.74	0.36	0.20	0.67

"C" Bars - 2 No 5 hoops 2" clear of top of manhole barrel section.
2 No 4 hoops 2" clear over pipe blockouts } Required for less than 2'-0" clearance between blockout and top of full thickness wall.

NOTES:

- Areas are in in²/ft of circumference and may be welded wire fabric, bars or a combination of both.
- Provide minimum longitudinal reinforcement, as shown, 1 inch clear of inside and outside faces, or at center of wall.
- Maximum longitudinal bar spacing is 12 inches center-to-center.
- Each "C" bar may be substituted with a 1/2" low-relaxation 7-wire prestressing strand, 15" minimum lap length, staggered.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Large Precast Conc. Manhole - Longitudinal Section Reinforcement



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Wade Ely
Chief Engineer

Calc. Book No.
001

Effective Date
01-01-09

Standard Drawing No.

P-146

108-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 9.0"			Tw = 10.0"			Tw = 10.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.28	0.19	0.38	0.25	0.17	0.34	0.23	0.15	0.31
	15 - 30	0.47	0.30	0.89	0.41	0.33	0.77	0.37	0.32	0.70
TYPE 2	0 - 15	0.30	0.19	0.43	0.28	0.17	0.38	0.26	0.15	0.35
	15 - 30	0.52	0.30	1.00	0.45	0.33	0.86	0.42	0.32	0.78
"C" Bars - 2 No 6 hoops 2" clear of top of manhole barrel section. 2 No 4 hoops 2" clear over pipe blockouts								} Required for less than 2'-0" clearance between blockout and top of full thickness wall.		

120-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 10.0"			Tw = 11.0"			Tw = 11.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.31	0.21	0.42	0.28	0.18	0.38	0.26	0.17	0.35
	15 - 30	0.53	0.33	1.02	0.47	0.37	0.90	0.43	0.36	0.82
TYPE 2	0 - 15	0.33	0.21	0.50	0.33	0.18	0.45	0.30	0.17	0.42
	15 - 30	0.57	0.33	1.12	0.50	0.37	1.00	0.47	0.36	0.90
"C" Bars - 2 No 7 hoops 2" clear of top of manhole barrel section. 2 No 4 hoops 2" clear over pipe blockouts								} Required for less than 2'-0" clearance between blockout and top of full thickness wall.		

132-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 11.0"			Tw = 12.0"			Tw = 12.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.34	0.22	0.46	0.31	0.20	0.42	0.28	0.19	0.39
	15 - 30	0.58	0.37	1.15	0.52	0.40	1.02	0.48	0.40	0.94
TYPE 2	0 - 15	0.37	0.22	0.55	0.36	0.20	0.50	0.33	0.19	0.46
	15 - 30	0.62	0.37	1.24	0.57	0.40	1.09	0.51	0.40	1.01
"C" Bars - 2 No 7 hoops 2" clear of top of manhole barrel section. 2 No 4 hoops 2" clear over pipe blockouts								} Required for less than 2'-0" clearance between blockout and top of full thickness wall.		

144-inch Diameter Manhole Section

Base Section Type	Depth (ft)	Tw = 12.0"			Tw = 13.0"			Tw = 13.75"		
	(Invert to street grade)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)	outside (in ² /ft)	inside (in ² /ft)	centered (in ² /ft)
TYPE 1	0 - 15	0.36	0.23	0.50	0.33	0.21	0.45	0.31	0.20	0.43
	15 - 30	0.63	0.40	1.27	0.57	0.44	1.13	0.54	0.43	1.05
TYPE 2	0 - 15	0.40	0.23	0.60	0.39	0.21	0.55	0.37	0.20	0.52
	15 - 30	0.68	0.40	1.39	0.62	0.44	1.24	0.58	0.43	1.15
"C" Bars - 2 No 8 hoops 2" clear of top of manhole barrel section. 2 No 4 hoops 2" clear over pipe blockouts								} Required for less than 2'-0" clearance between blockout and top of full thickness wall.		

NOTES:

- Areas are in in²/ft of circumference and may be welded wire fabric, bars or a combination of both.
- Provide minimum longitudinal reinforcement, as shown, 1 inch clear of inside and outside faces, or at center of wall.
- Maximum longitudinal bar spacing is 12 inches center-to-center.
- Each "C" bar may be substituted with a 1/2" low-relaxation 7-wire prestressing strand, 15" minimum lap length, staggered.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Large Precast Conc. Manhole - Longitudinal Section Reinforcement



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Walter F. ...
Chief Engineer

Calc. Book No.

001

Effective Date

01-01-09

Standard Drawing No.

P-147

Top Slab "A"	
Cover Depth	Manhole Dia (in)
6" to 15"	48
T (in)	8
Reinforcement	refer to diagram

Top Slab "B"								
Cover Depth	Manhole Diameter (in)							
6" to 22"	60	72	84	96	108	120	132	144
T (in)	9	10	11	12	N/A			
"A" Bars (under)	No 5 @ 7"	No 5 @ 7"	No 5 @ 7"	No 5 @ 6"	N/A			
"B" Bars (over)	No 5 @ 7"	No 5 @ 7"	No 5 @ 7"	No 5 @ 6"	N/A			

Top Slab "C"	
Cover Depth	Manhole Dia (in)
6" to 22"	48
T (in)	10
"A" Bars (under)	No 5 @ 4" long
"B" Bars (over)	No 5 @ 4" diag**

Top Slab "D"								
Cover Depth	Manhole Diameter (in)							
6" to 22"	60	72	84	96	108	120	132	144
T (in)	10	10	11	12	12	12	14	14
"A" Bars (under)	No 5 @ 8"	No 5 @ 7"	No 5 @ 6"	No 5 @ 6"	No 6 @ 8"	No 6 @ 7"	No 6 @ 8"	No 6 @ 7"
"B" Bars (over)	No 5 @ 8"	No 5 @ 7"	No 5 @ 6"	No 5 @ 6"	No 6 @ 8"	No 6 @ 7"	No 6 @ 8"	No 6 @ 7"
Temperature Reinforcement	N/A						No. 4 @ 12" E.W.	No. 4 @ 12" E.W.

NOTE:

** See detail drawings for reinforcement layout.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products

Appendix A

Precast Concrete Manhole - Top Slabs "A" through "D"



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Chief Engineer

Calc. Book No.

001

Effective Date

01-01-09

Standard Drawing No.

P-148

Top Slab "E"

Cover Depth	Manhole Diameter (in)							
42" to 7'	60	72	84	96	108	120	132	144
T (in)	12	12	12	12	12	12	14	14
"A" Bars (under)	No 5 @ 4" long	No 5 @ 8"	No 5 @ 6"	No 5 @ 6"	No 6 @ 7"	No 6 @ 7"	No 6 @ 6"	No 7 @ 8"
"B" Bars (over)	No 5 @ 4" diag**	No 5 @ 8"	No 5 @ 6"	No 5 @ 6"	No 6 @ 7"	No 6 @ 7"	No 6 @ 6"	No 7 @ 8"
Temperature Reinforcement	N/A						No. 4 @ 12" E.W.	No. 4 @ 12" E.W.

Cover Depth	Manhole Diameter (in)							
7' to 22'	60	72	84	96	108	120	132	144
T (in)	12	12	12	14	16	16	16	16
"A" Bars (under)	No 5 @ 4" long	No 5 @ 6"	No 6 @ 5"	No 6 @ 5"	No 7 @ 6"	No 8 @ 7"	No 8 @ 6"	No 9 @ 7"
"B" Bars (over)	No 5 @ 4" diag**	No 5 @ 6"	No 6 @ 5"	No 6 @ 5"	No 7 @ 6"	No 8 @ 7"	No 8 @ 6"	No 9 @ 7"
Temperature Reinforcement	N/A			No. 4 @ 12" E.W.	No. 4 @ 12" E.W.	No. 4 @ 12" E.W.	No. 4 @ 12" E.W.	No. 4 @ 12" E.W.

Precast Manhole Base Slab

0 - 15' depth	Manhole Diameter (in)							
	60	72	84	96	108	120	132	144
Ts (in)	11	11	12	12	13	13	14	14
"E" Bars	No 4 @ 10"	No 4 @ 8"	No 4 @ 6"	No 5 @ 7"	No 5 @ 6"	No 6 @ 7"	No 6 @ 6"	No 6 @ 5"

15' to 30' depth	Manhole Diameter (in)							
	60	72	84	96	108	120	132	144
Ts (in)	12	12	13	14	15	16	17	18
"E" Bars	No 4 @ 8"	No 5 @ 8"	No 5 @ 7"	No 5 @ 6"	No 6 @ 6"	No 6 @ 6"	No 6 @ 5"	No 6 @ 5"

NOTE:

** See detail drawings for reinforcement layout.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Manufacturing Standards for Precast Concrete Products**Appendix A****Precast Concrete Manhole - Top Slab "E" and Base Slabs**

Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Walter F. [Signature]
Chief Engineer

Calc. Book No.

001

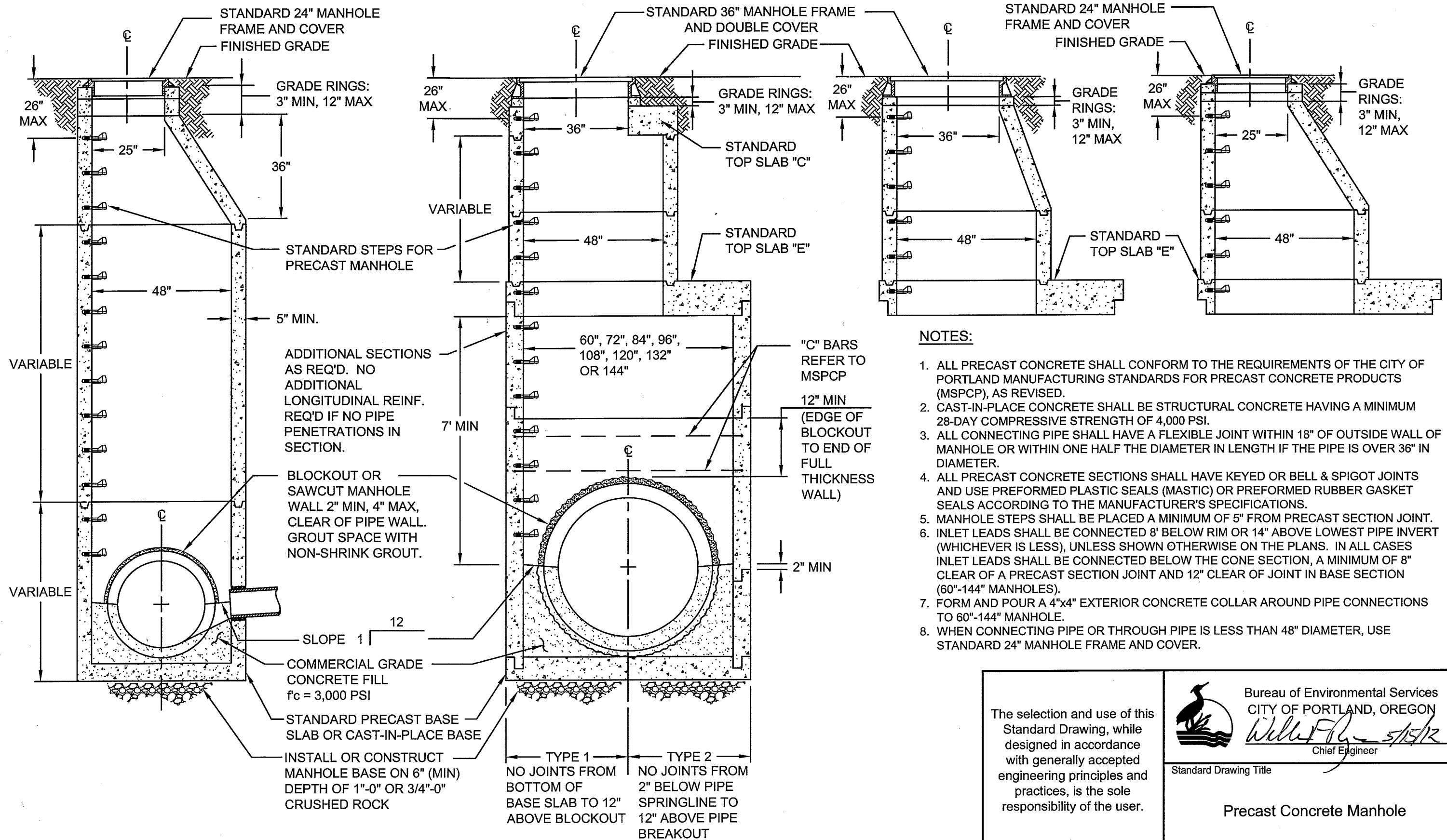
Effective Date

01-01-09

Standard Drawing No.

P-149

P-150_PRECAST_CONC_MANHOLE.DWG 5/10/12 4:18 PM RICKS



NOTES:

1. ALL PRECAST CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. CAST-IN-PLACE CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
3. ALL CONNECTING PIPE SHALL HAVE A FLEXIBLE JOINT WITHIN 18" OF OUTSIDE WALL OF MANHOLE OR WITHIN ONE HALF THE DIAMETER IN LENGTH IF THE PIPE IS OVER 36" IN DIAMETER.
4. ALL PRECAST CONCRETE SECTIONS SHALL HAVE KEYED OR BELL & SPIGOT JOINTS AND USE PREFORMED PLASTIC SEALS (MASTIC) OR PREFORMED RUBBER GASKET SEALS ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
5. MANHOLE STEPS SHALL BE PLACED A MINIMUM OF 5" FROM PRECAST SECTION JOINT.
6. INLET LEADS SHALL BE CONNECTED 8' BELOW RIM OR 14" ABOVE LOWEST PIPE INVERT (WHICHEVER IS LESS), UNLESS SHOWN OTHERWISE ON THE PLANS. IN ALL CASES INLET LEADS SHALL BE CONNECTED BELOW THE CONE SECTION, A MINIMUM OF 8" CLEAR OF A PRECAST SECTION JOINT AND 12" CLEAR OF JOINT IN BASE SECTION (60"-144" MANHOLES).
7. FORM AND POUR A 4"x4" EXTERIOR CONCRETE COLLAR AROUND PIPE CONNECTIONS TO 60"-144" MANHOLE.
8. WHEN CONNECTING PIPE OR THROUGH PIPE IS LESS THAN 48" DIAMETER, USE STANDARD 24" MANHOLE FRAME AND COVER.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Note:
All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Will F. Ricks 5/15/12
Chief Engineer

Standard Drawing Title

Precast Concrete Manhole

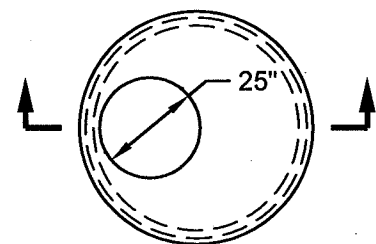
Effective Date: 01-01-09

Calc. Book No.: 001

Baseline Report Date: 03-24-09

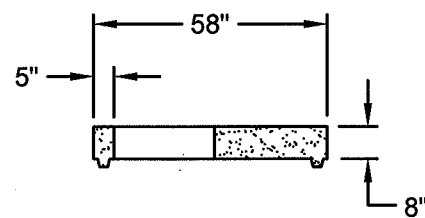
Standard Drawing No.

P-150

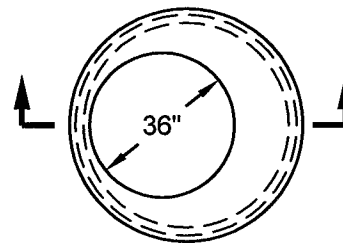


TOP SLAB "A"

- FOR USE WITH 48" MANHOLES OR RISER SECTIONS AND STANDARD 24" MANHOLE FRAME.
- COVER DEPTH LESS THAN 15 INCHES.

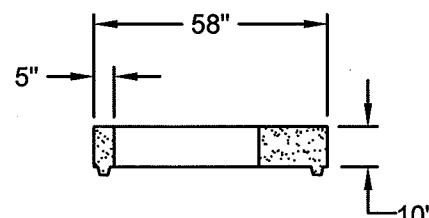


SECTION

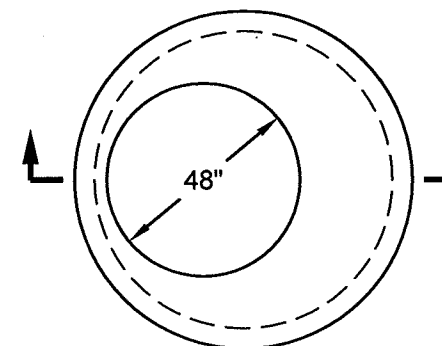


TOP SLAB "C"

- FOR USE WITH 48" MANHOLES OR RISER SECTIONS AND STANDARD 36" MANHOLE FRAME.
- COVER DEPTH LESS THAN 22 INCHES.

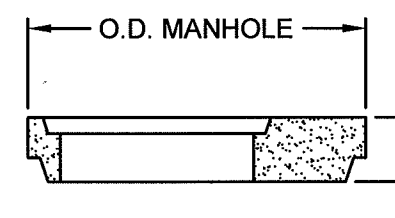


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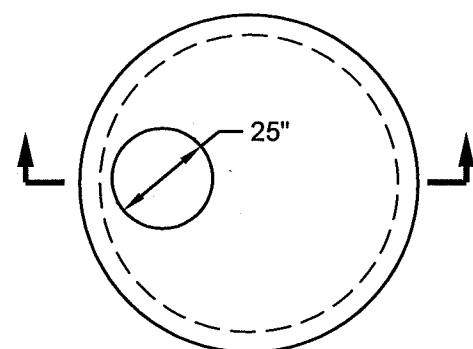


TOP SLAB "E" (REDUCING SLAB)

- FOR USE WITH 60" - 144" MANHOLES AND 48" RISER OR CONE SECTIONS.
- COVER DEPTH 42" TO 22'.

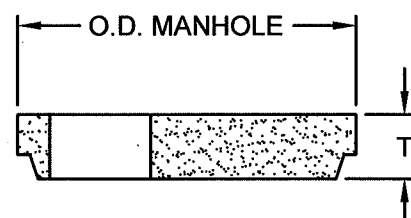


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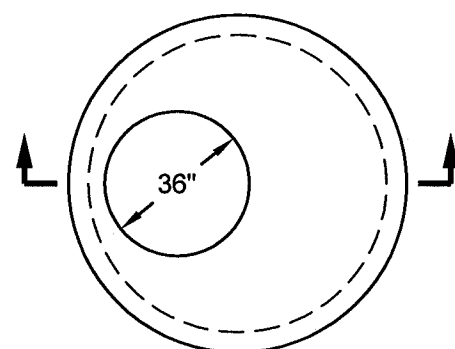


TOP SLAB "B"

- FOR USE WITH 60" - 96" MANHOLES AND STANDARD 24" MANHOLE FRAME.
- COVER DEPTH LESS THAN 22 INCHES.

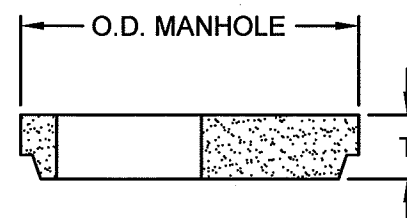


SECTION



TOP SLAB "D"

- FOR USE WITH 60" - 144" MANHOLES AND STANDARD 36" MANHOLE FRAME.
- COVER DEPTH LESS THAN 22 INCHES.



SECTION

NOTES:

1. ALL PRECAST CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. FOR EACH TOP SLAB, REFER TO MSPCP FOR COMPLETE SIZE AND REINFORCEMENT DETAILS.
3. ALL TOP SLABS SHALL HAVE KEYED OR BELL & SPIGOT JOINTS AND SHALL USE PREFORMED PLASTIC SEALS (MASTIC) OR PREFORMED RUBBER GASKET SEALS ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Walter Fly
Chief Engineer

Standard Drawing Title

Top Slabs for
Precast Concrete Manholes

Note:
All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.

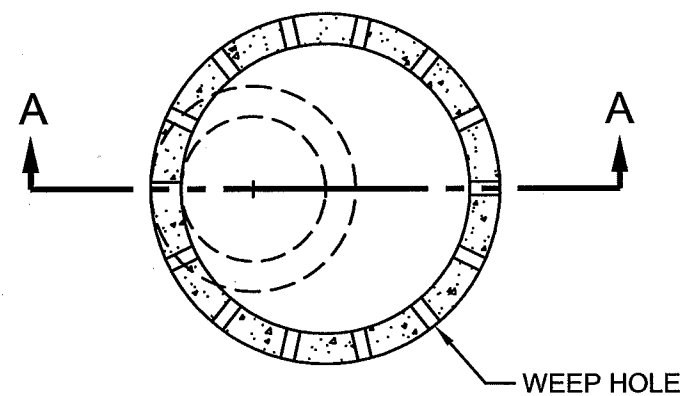
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Calc. Book No.: 001

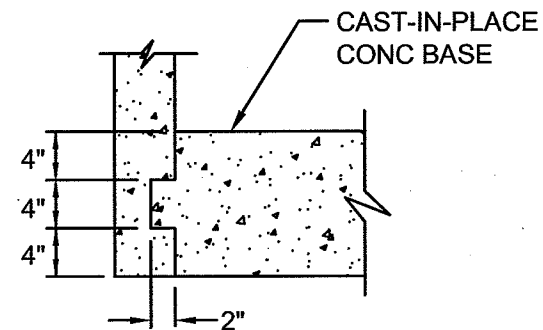
Baseline Report Date: 03-24-09

Standard Drawing No.

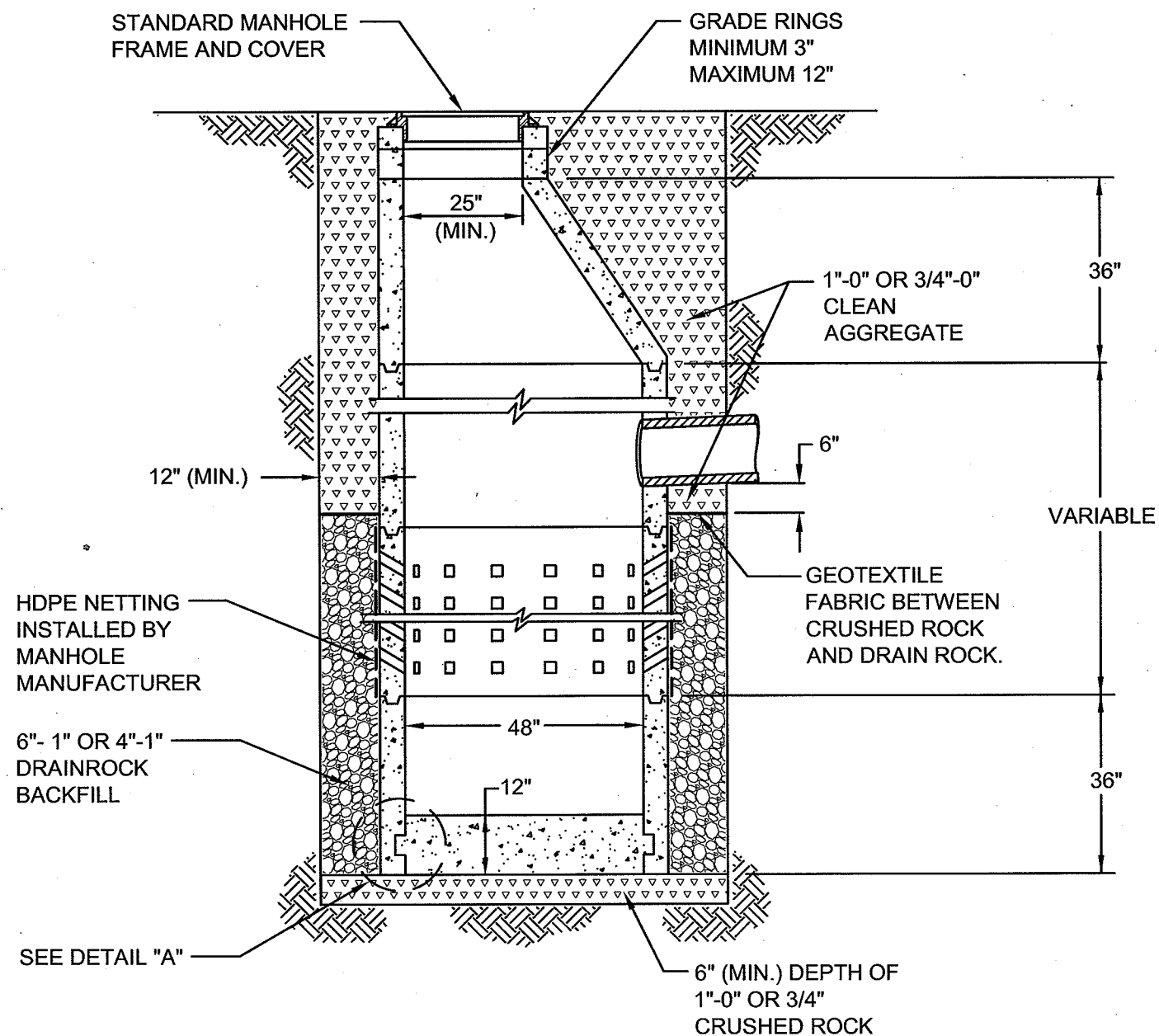
P-152



PLAN



DETAIL "A"

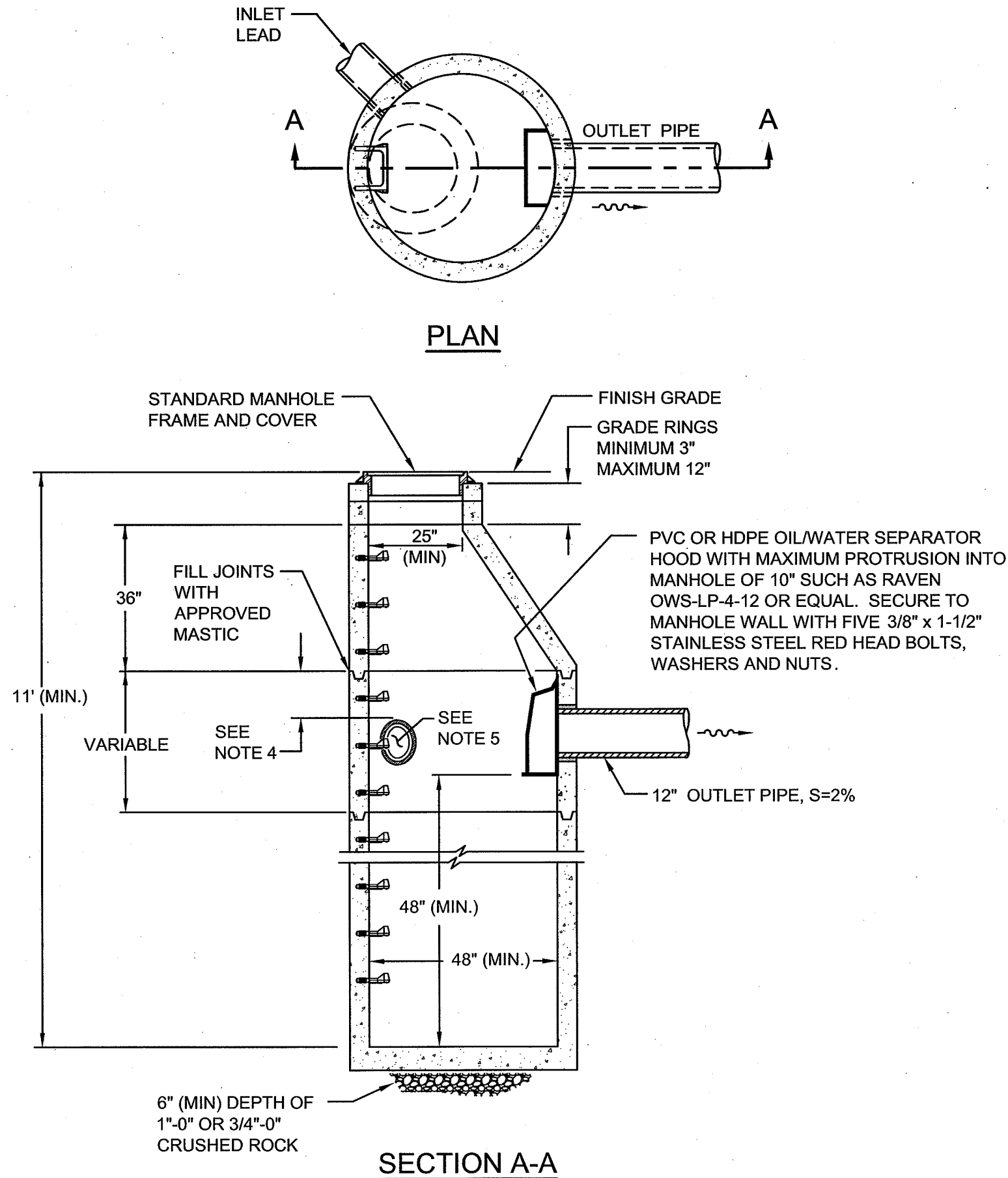


SECTION A-A

NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. PROVIDE 6 INCHES CLEAN CRUSHED ROCK UNDER ALL CONNECTING PIPE.
3. DO NOT CONNECT PIPE TO ANY PERFORATED SECTION. PROVIDE 48 INCHES OF SEPARATION BETWEEN THE CONE BASE AND ANY WEEP HOLES.
4. CAST-IN-PLACE CONCRETE SHALL BE COMMERCIAL GRADE. FORM BASE TO BE LEVEL AND SMOOTH. A PRECAST CONCRETE BASE MAY BE SUBSTITUTED FOR THE BASE SHOWN.
5. PROVIDE A FLEXIBLE JOINT FOR ALL CONNECTING PIPES:
 - RIGID PIPE < 36 INCHES – 18 INCHES (MAX.) FROM OUTSIDE WALL
 - FLEXIBLE PIPE – 18 INCHES (MAX.) FROM THE OUTSIDE WALL UNLESS A FLEXIBLE JOINT FITTING IS INSTALLED AND ACCEPTED.
6. PROVIDE 12 INCHES (MIN.) OF SEPARATION BETWEEN A SECTION JOINT AND THE OUTER EDGE OF ANY OPENING

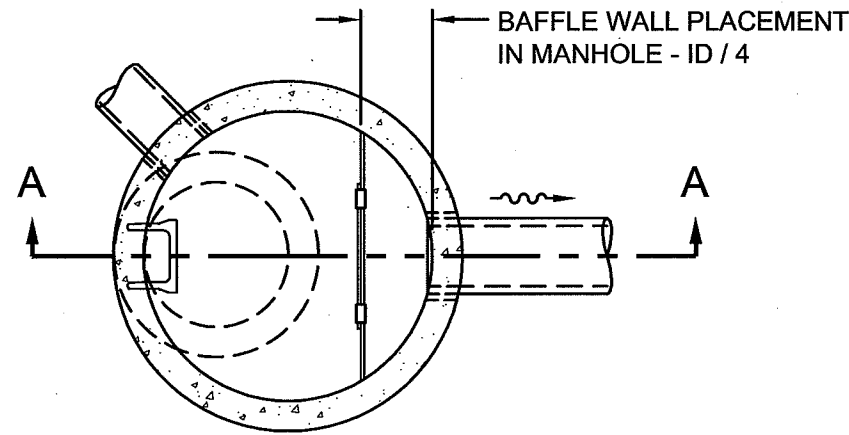
The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	Bureau of Environmental Services CITY OF PORTLAND, OREGON <i>Will F. Fly</i> Chief Engineer	
	Standard Detail Title Precast Sump	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	Effective Date: 01-01-09	Standard Detail No. P-160
	Calc. Book No.: N/A	
	Baseline Report Date: N/A	



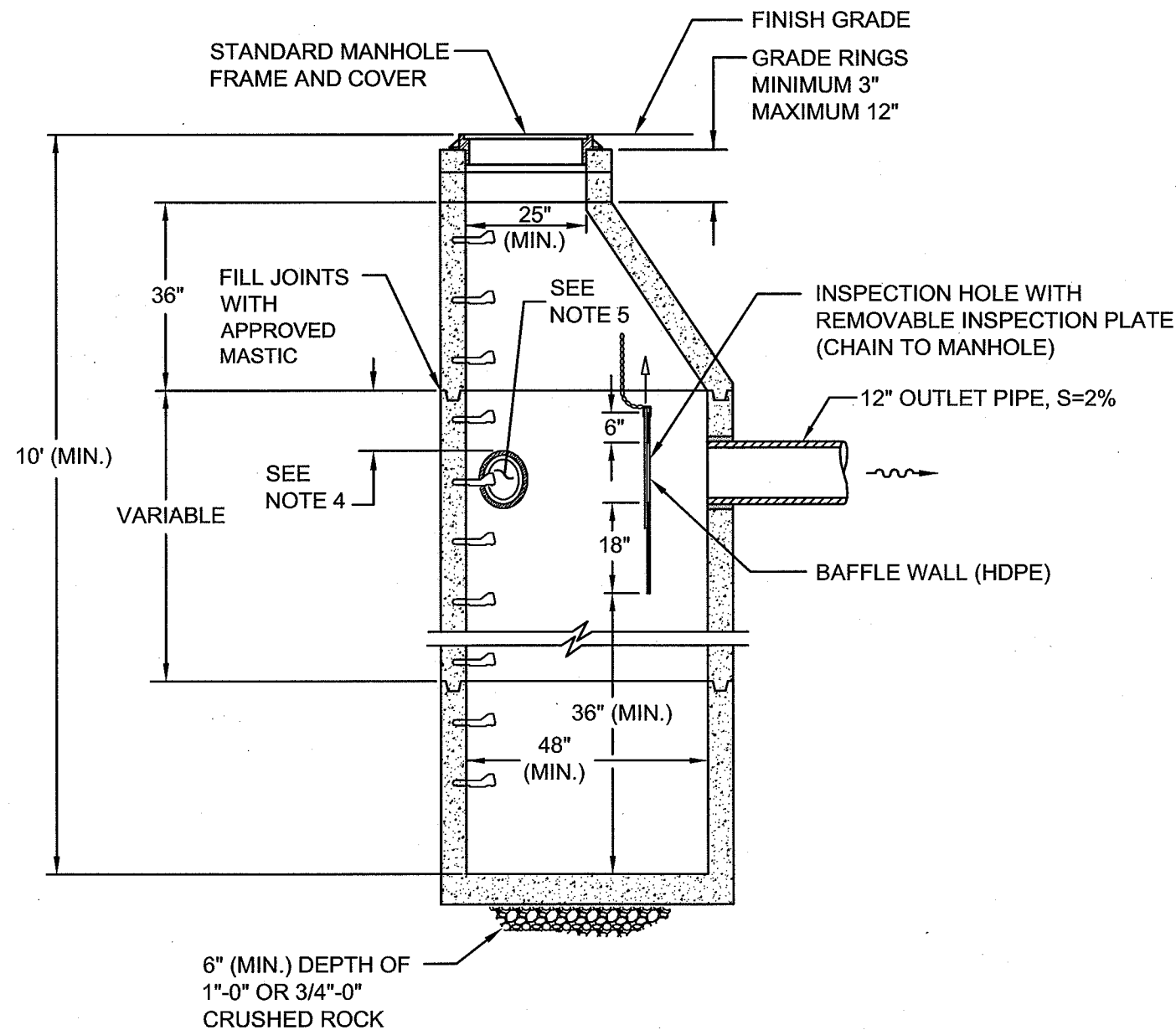
NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. MANHOLE STEPS – REFER TO THE STANDARD DETAIL P-168.
3. PROVIDE A FLEXIBLE JOINT FOR ALL CONNECTED PIPES:
 - RIGID PIPE < 36 INCHES – 18 INCHES (MAX.) FROM OUTSIDE WALL
 - FLEXIBLE PIPE – 18 INCHES (MAX.) FROM THE OUTSIDE WALL UNLESS A FLEXIBLE JOINT FITTING IS INSTALLED AND ACCEPTED.
4. PROVIDE 12 INCHES (MIN.) OF SEPARATION BETWEEN A SECTION JOINT AND THE OUTER EDGE OF ANY OPENING.
5. LOCATE INVERT OF ANY INLET LEAD 6 INCHES (MIN.) ABOVE THE OUTLET PIPE INVERT

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	Bureau of Environmental Services CITY OF PORTLAND, OREGON <i>William F. Ricks</i> Chief Engineer	
	Standard Detail Title Sedimentation Manhole with Hood	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	Effective Date: 01-01-09	Standard Detail No. P-161
	Calc. Book No.: N/A	
	Baseline Report Date: N/A	



PLAN



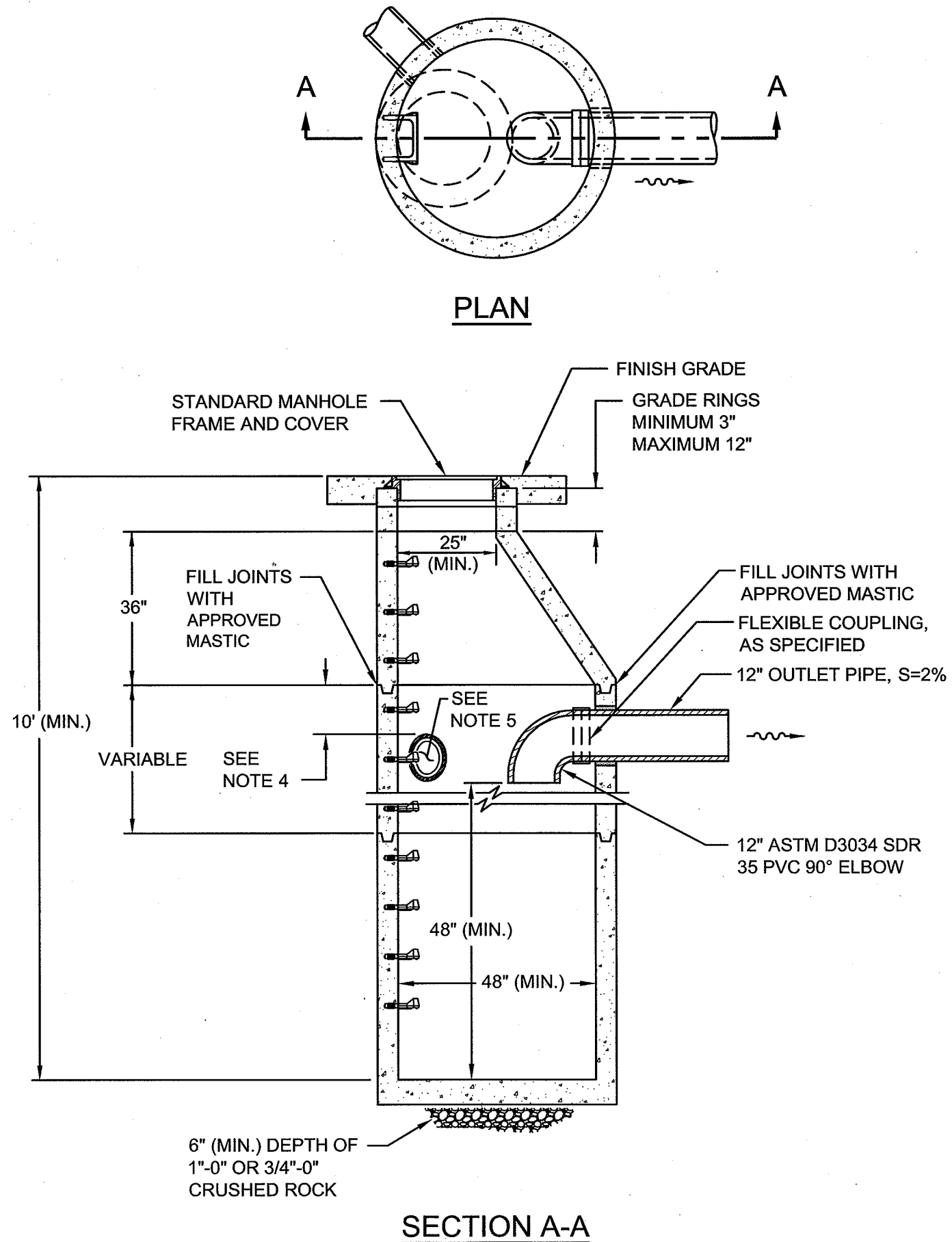
SECTION A-A

NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. MANHOLE STEPS – REFER TO THE STANDARD DETAIL P-168.
3. PROVIDE A FLEXIBLE JOINT FOR ALL CONNECTED PIPES:
 - RIGID PIPE < 36 INCHES – 18 INCHES (MAX.) FROM OUTSIDE WALL
 - FLEXIBLE PIPE – 18 INCHES (MAX.) FROM THE OUTSIDE WALL UNLESS A FLEXIBLE JOINT FITTING IS INSTALLED AND ACCEPTED.
4. PROVIDE 12 INCHES (MIN.) OF SEPARATION BETWEEN A SECTION JOINT AND THE OUTER EDGE OF ANY OPENING.
5. LOCATE INVERT OF ANY INLET LEAD 6 INCHES (MIN.) ABOVE THE OUTLET PIPE INVERT.
6. BAFFLE WALL AND THE REMOVABLE INSPECTION PLATE MATERIAL SHALL BE 1/2 INCH THICK HIGH DENSITY POLYETHYLENE (HDPE) FLAT STOCK. SECURE BAFFLE WALL TO MANHOLE WALL WITH SIX STAINLESS STEEL BRACKETS (MIN).
7. PROVIDE A 12 INCH DIA. INSPECTION HOLE CENTERED IN THE BAFFLE WALL. CHAIN REMOVABLE PLATE TO MANHOLE WALL.

P-162_SED_MANHOLE_BAFFLE.DWG 4/7/09 8:40 AM RICKS

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	 Bureau of Environmental Services CITY OF PORTLAND, OREGON  Chief Engineer	
	Standard Detail Title	
	Sedimentation Manhole with Baffle	
	Standard Detail No.	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	Effective Date: 01-01-09	P-162
	Calc. Book No.: N/A	
	Baseline Report Date: N/A	



NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. MANHOLE STEPS – REFER TO THE STANDARD DETAIL P-168.
3. PROVIDE A FLEXIBLE JOINT FOR ALL CONNECTED PIPES:
 - RIGID PIPE < 36 INCHES – 18 INCHES (MAX.) FROM OUTSIDE WALL
 - FLEXIBLE PIPE – 18 INCHES (MAX.) FROM THE OUTSIDE WALL UNLESS A FLEXIBLE JOINT FITTING IS INSTALLED AND ACCEPTED.
4. PROVIDE 12 INCHES (MIN.) OF SEPARATION BETWEEN A SECTION JOINT AND THE OUTER EDGE OF ANY OPENING.
5. LOCATE INVERT OF ANY INLET LEAD 6 INCHES (MIN.) ABOVE THE OUTLET PIPE INVERT.

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.



Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Walter F. Ricks
Chief Engineer

Standard Detail Title

Sedimentation Manhole with Elbow

Note:
All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.

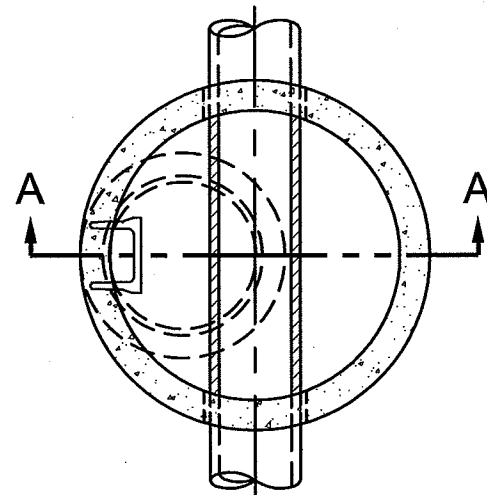
Effective Date: 01-01-09

Calc. Book No.: N/A

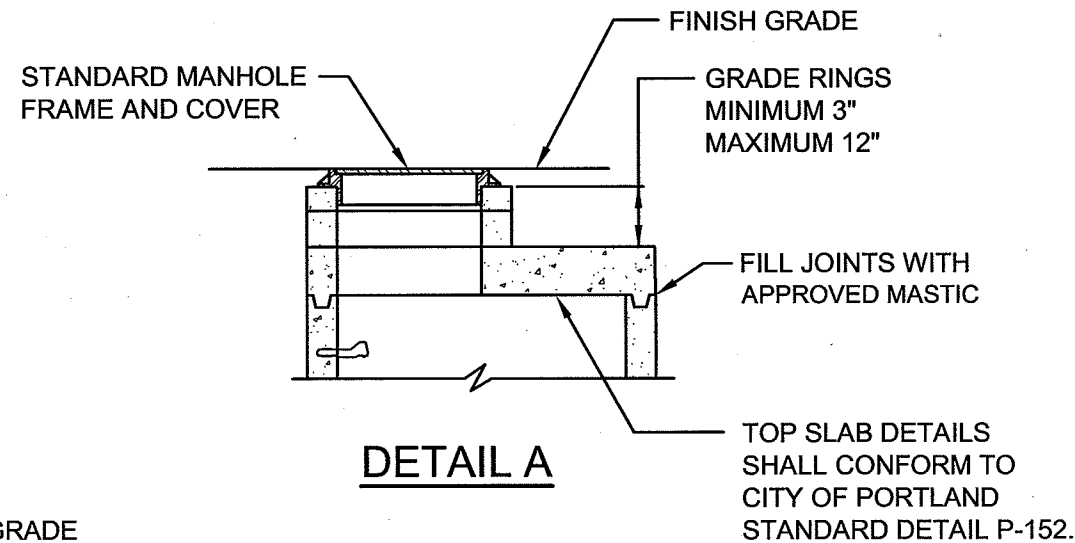
Baseline Report Date: N/A

Standard Detail No.

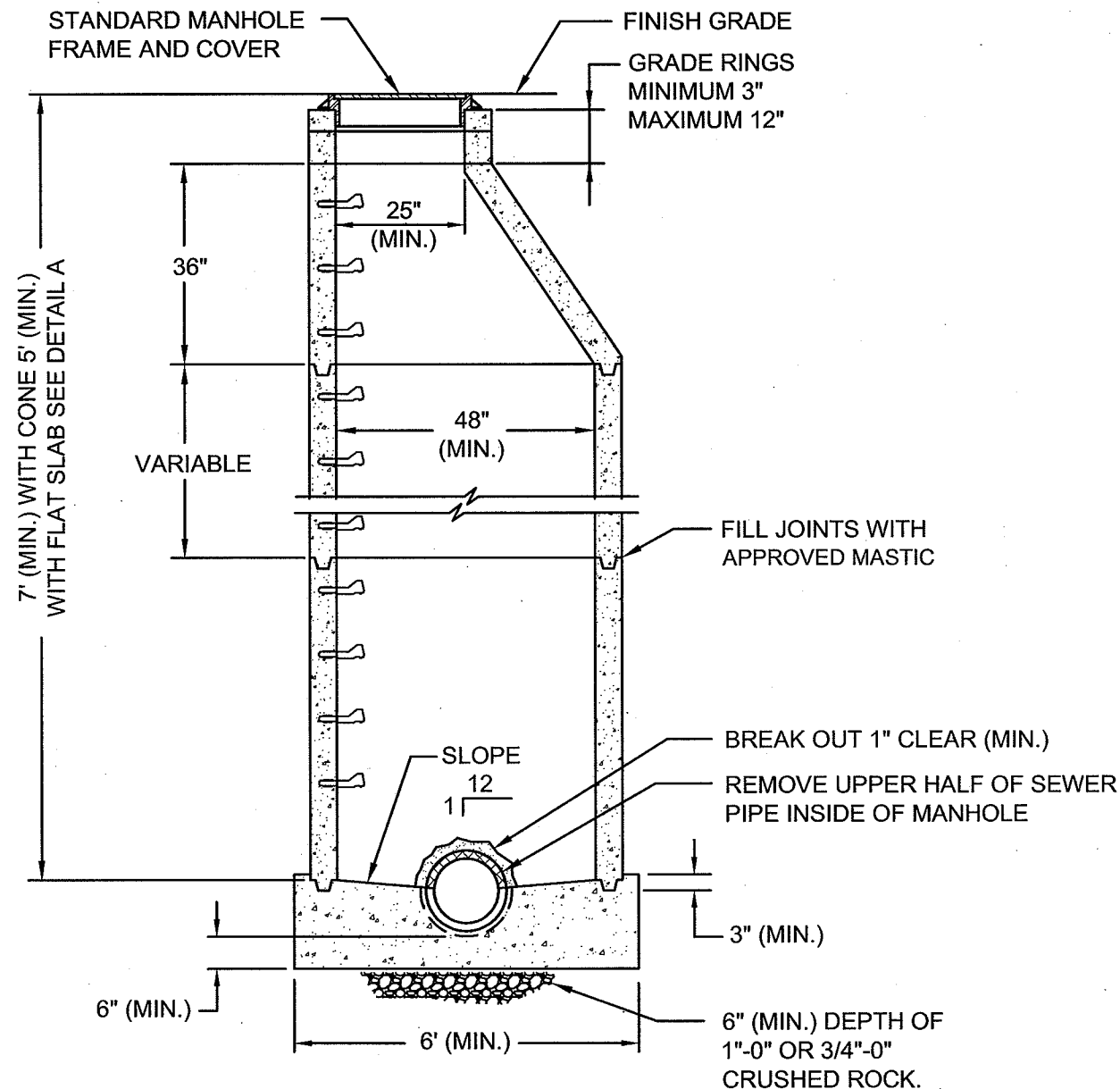
P-163



PLAN



DETAIL A



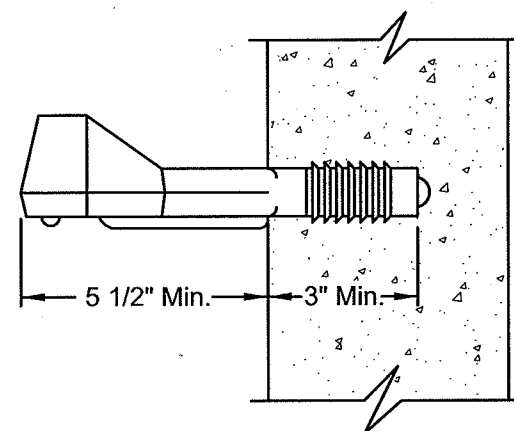
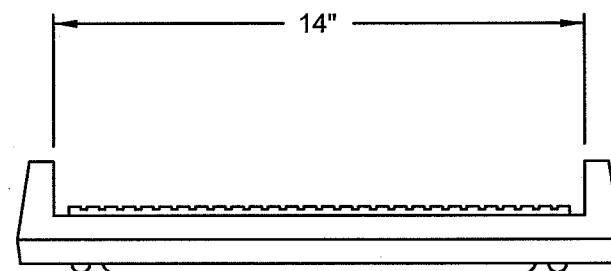
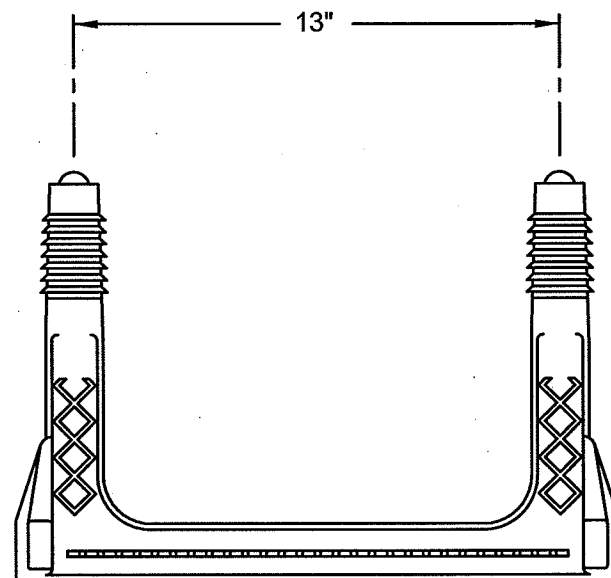
SECTION A-A

NOTES:

1. ALL PRECAST SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
2. MANHOLE STEPS – REFER TO THE STANDARD DETAIL P-168.
3. PROVIDE A FLEXIBLE JOINT FOR ALL CONNECTED PIPES:
 - RIGID PIPE < 36 INCHES – 18 INCHES (MAX.) FROM OUTSIDE WALL
 - FLEXIBLE PIPE – 18 INCHES (MAX.) FROM THE OUTSIDE WALL UNLESS A FLEXIBLE JOINT FITTING IS INSTALLED AND ACCEPTED.

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	Bureau of Environmental Services CITY OF PORTLAND, OREGON <i>Walter E. Fly</i> Chief Engineer	
	Standard Detail Title Sampling Manhole	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	Effective Date: 01-01-09	Standard Detail No. P-164
	Calc. Book No.: N/A	
	Baseline Report Date: N/A	

P-168_STEP_PRECAST_MANHOLE.DWG 4/6/09 5:57 PM RICKS



NOTES:

1. ONLY USE CITY CERTIFIED STEPS IN ALL MANHOLES. A CURRENT LIST OF CERTIFIED STEPS CAN BE OBTAINED FROM THE CITY OF PORTLAND MATERIALS TESTING LAB (503) 823-2340.
2. ALL STEPS SHALL BE OF THE SAME DESIGN, TYPE AND SIZE AND INSTALLED IN CONFORMANCE WITH THE MSPCP AND THE MANUFACTURER'S RECOMMENDATIONS.
3. FOR PRECAST MANHOLES THE MANUFACTURER SHALL INSTALL THE STEPS BEFORE DELIVERY TO THE JOB SITE.
4. LOOSE STEPS WILL NOT BE ACCEPTED. IN PRECAST MANHOLES LOOSE STEPS SHALL BE CAUSE FOR REJECTION OF THE MANHOLE CONE OR SECTION.
5. LOCATE THE FIRST MANHOLE STEP 6 INCHES BELOW THE TOP OF CONE AND NOT MORE THAN 26 INCHES BELOW FINISH GRADE. SUCCEEDING STEP SHALL BE SPACED 12 INCHES ON CENTER.
6. STEPS SHALL BE ALIGNED VERTICALLY.

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	 Bureau of Environmental Services CITY OF PORTLAND, OREGON  Chief Engineer	
	Standard Detail Title	
	Step for Precast Manhole	
	Effective Date: 01-01-09	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	Standard Detail No.	
	Calc. Book No.: N/A	
	Baseline Report Date: N/A	
		P-168

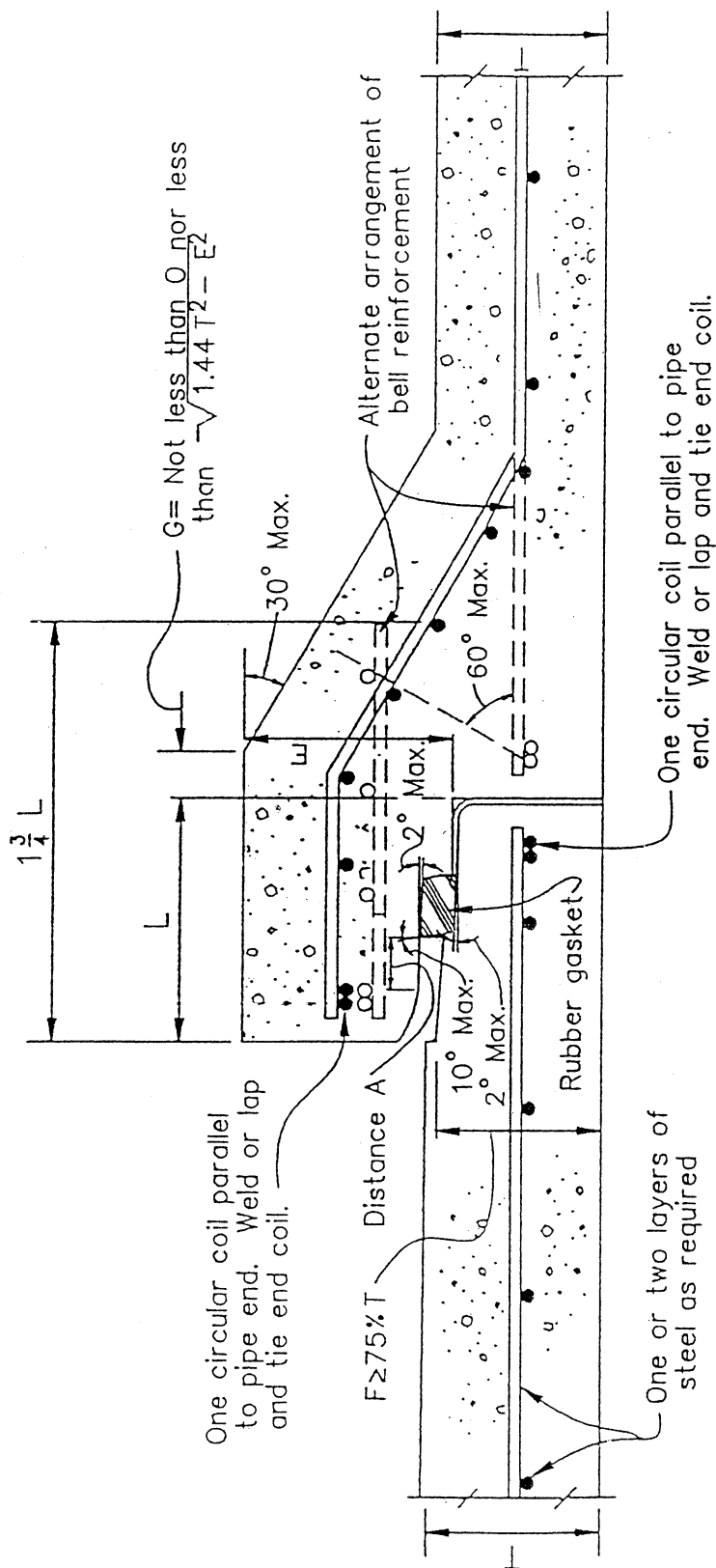
APPENDIX B – Concrete Pipe Joint – Details and Forms

Concrete Pipe Joint Details:

Figure 1	Joint Type R-3 (T = 2" to 4 1/2" Inclusive)
Figure 2	Joint Type R-3 (T = 4 5/8" and Larger)
Figure 3	Joint Type R-4 (T = 2" to 4 1/2" Inclusive)
Figure 4	Joint Type R-4 (T = 4 5/8" and Larger)

Forms:

Figure 5	Joint Data Form
Figure 6	Gasket Quality Report Form

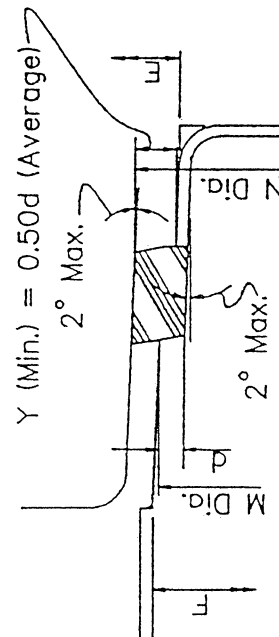


NOTES

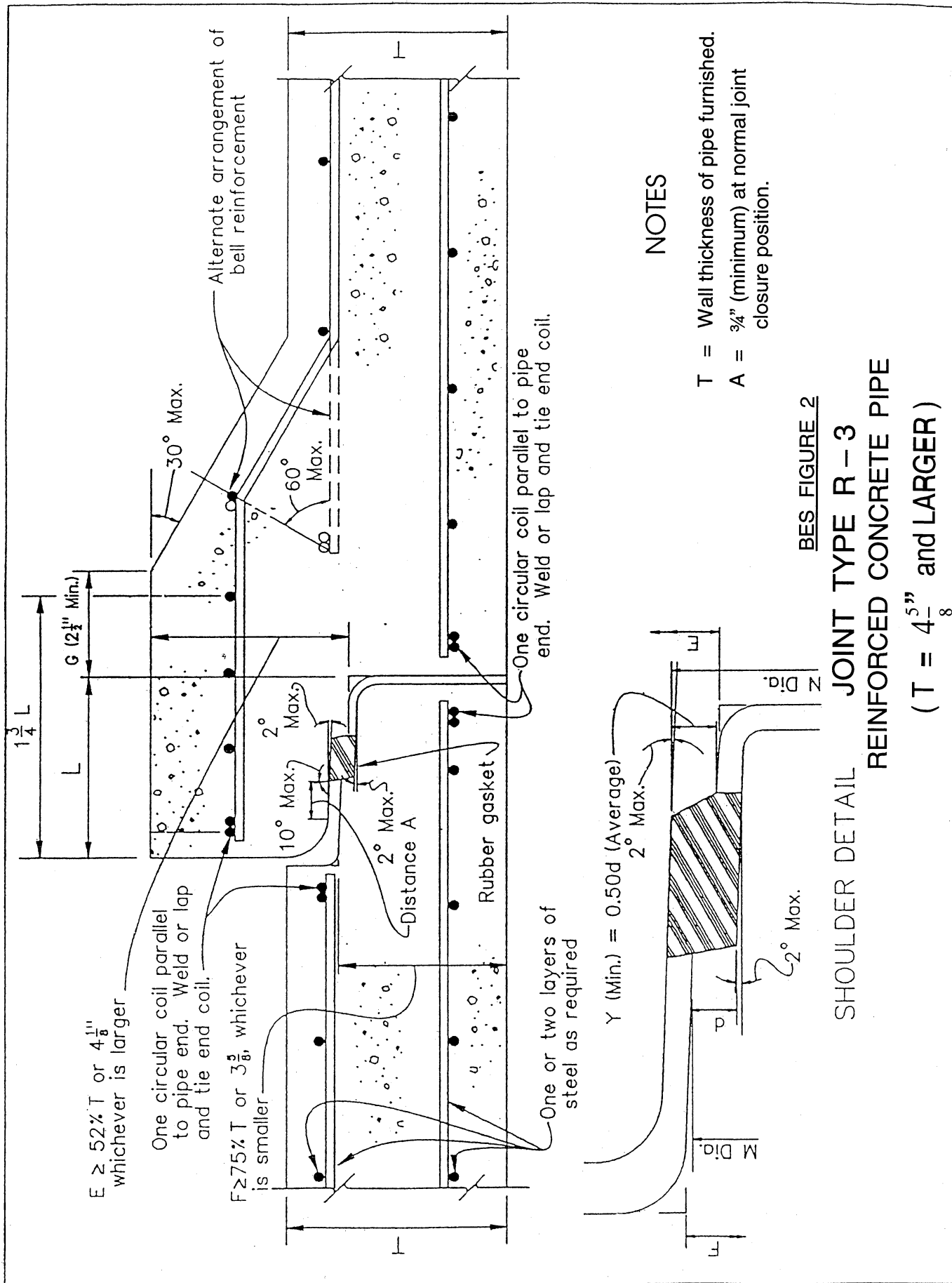
T = Wall thickness of pipe furnished.

E = $\geq T$ or $4\frac{1}{8}$ " whichever is smaller.

A = $\frac{3}{4}$ " (minimum) at normal joint closure position.

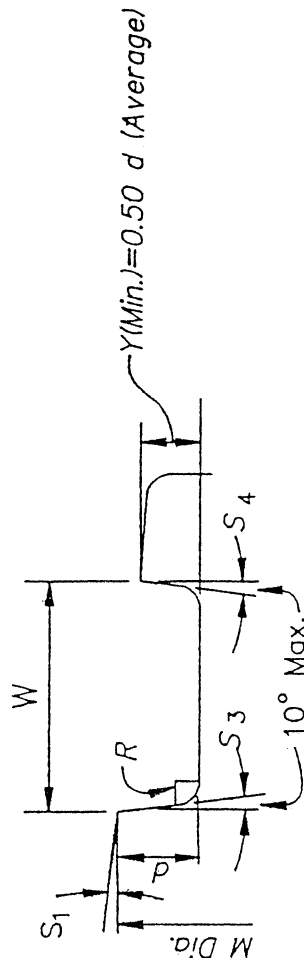
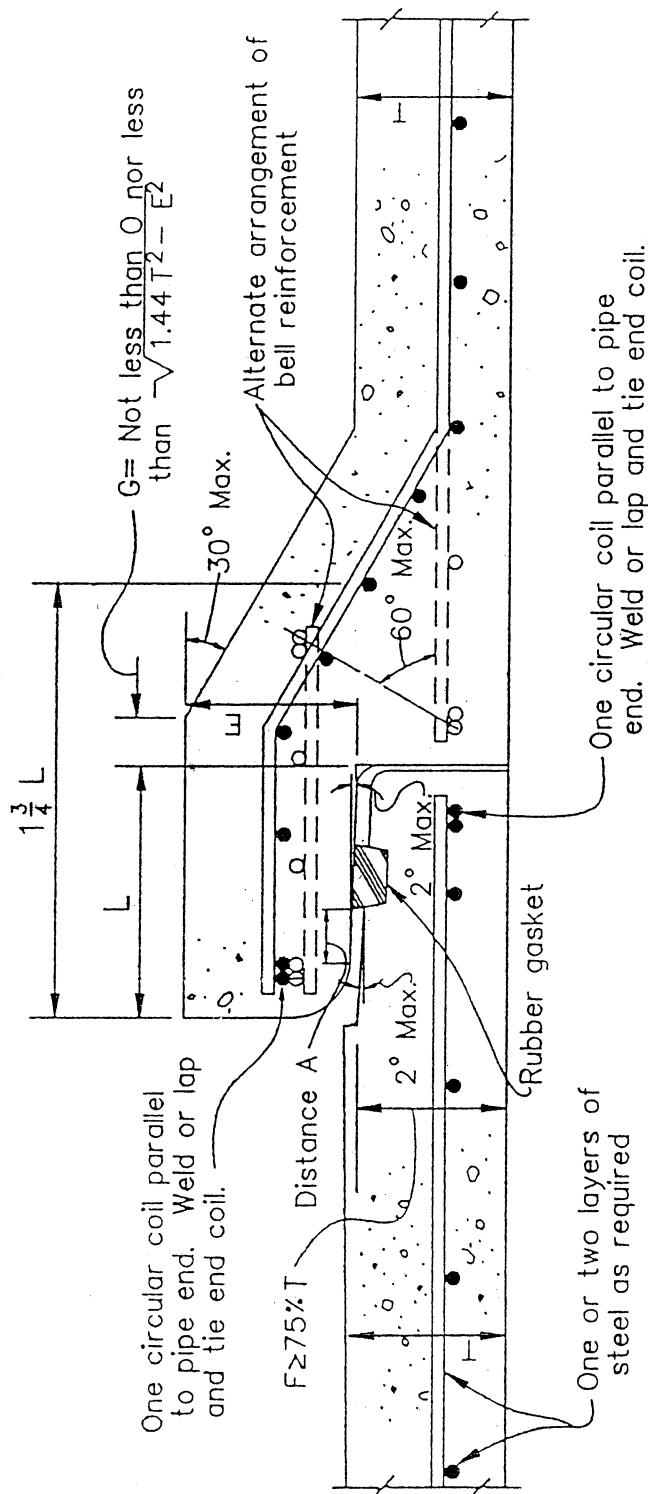


BES FIGURE 1
JOINT TYPE R-3
REINFORCED CONCRETE PIPE
(T = 2" TO 4 1/2" INCLUSIVE)



BES FIGURE 2

SHOULDER DETAIL JOINT TYPE R - 3
 REINFORCED CONCRETE PIPE
 ($T = 4\frac{5}{8}"$ and LARGER)



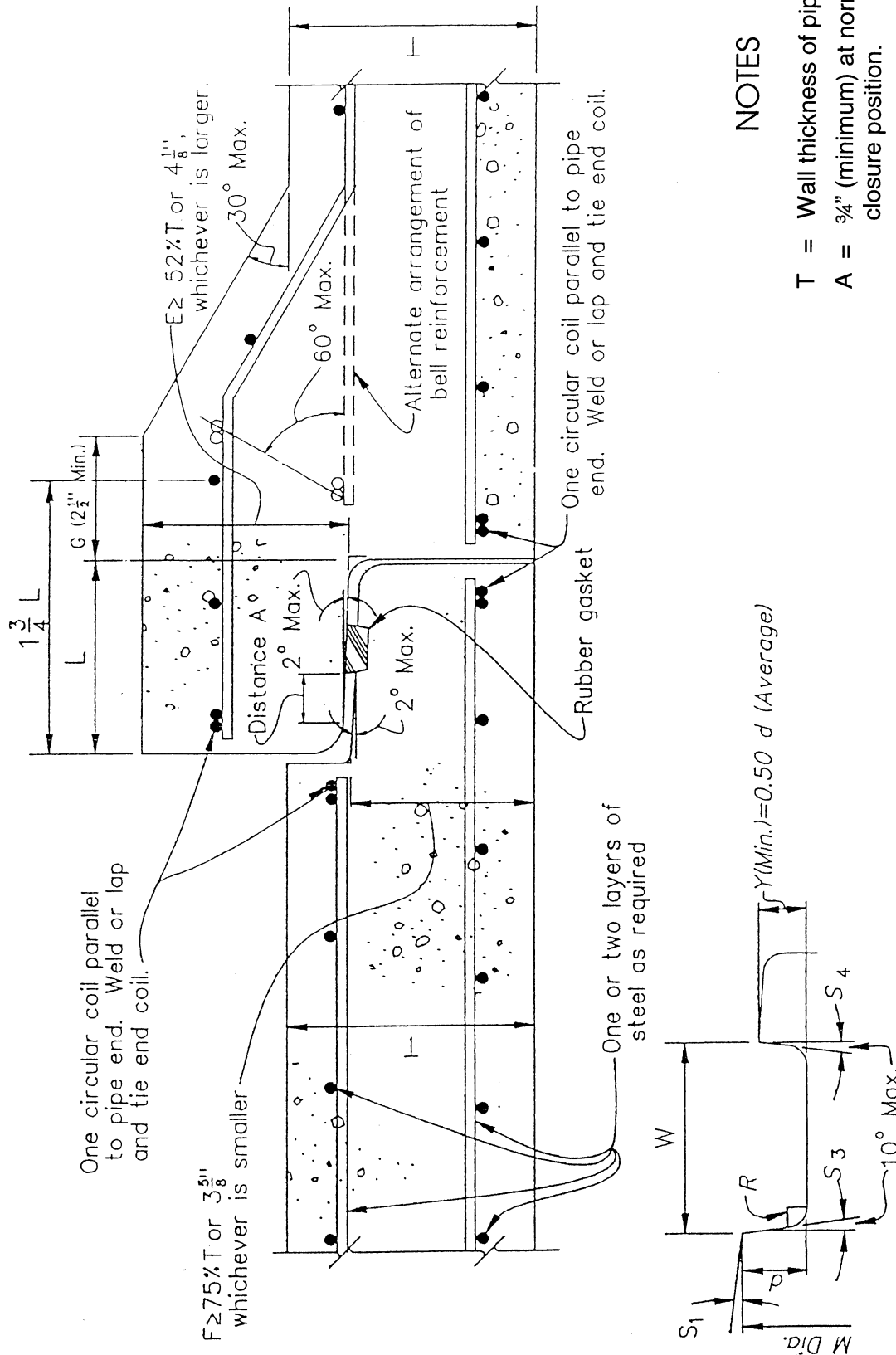
NOTES

- T = Wall thickness of pipe furnished.
 $E = \geq T$ or $4\frac{1}{8}$ " whichever is smaller.
A = $\frac{3}{4}$ " (minimum) at normal joint closure position.

SPIGOT GROOVE DETAIL

BES FIGURE 3

JOINT TYPE R-4 REINFORCED CONCRETE PIPE (T = 2" TO 4 1/2" INCLUSIVE)



NOTES

- T = Wall thickness of pipe furnished.
A = $\frac{3}{4}$ " (minimum) at normal joint closure position.

BES FIGURE 4
JOINT TYPE R-4
REINFORCED CONCRETE PIPE
(T = $4\frac{5}{8}$ " and LARGER)

SPIGOT GROOVE DETAIL



CITY OF PORTLAND ENVIRONMENTAL SERVICES



MATERIALS TESTING LABORATORY 1405 N. River St., Portland, OR 97227

Phone: 503-823-2340 FAX: 503-823-2342

GASKET QUALITY REPORT

Instructions

Test one gasket of each 100 for sizes through 36" and one for each 300 for sizes over 36".

Gaskets should be picked at random and not all from the same box.

Plant: _____ Date Received: _____

Vendor Name: _____ Date Tested: _____

Vendor Order No.: _____ P.O. No.: _____

Quantity Received: _____ Quantity Tested: _____

Test Data

Gasket Number	Gasket Size	Height or Dia. (Inches)	Cut Length (Inches)	Wt. in Air (Grams)	Wt. in Water (Grams)	Volume (c.c.)	Duro	Splice
PCs.								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Printing on gasket: _____

Do all gaskets meet specifications? ☐ Yes ☐ No

Circle All Gasket Measurements Out of Specifications

Comments: _____

Signed: _____ Date: _____

APPENDIX C – New Concrete Product Repair Standards

Class of Damage/Defect	Description	Location	Extent	Repair procedure
Class A1, non-structural	Bug holes and air voids	All locations except gasket seating areas	greatest cross-sectional dimension >1/2-inch or depth >1/4-inch	Submit repair
Class A2, non-structural		gasket seating areas	greatest cross-sectional dimension >1/8-inch or depth >1/8-inch	Submit repair
Class B, non-structural		gasket seating areas	greatest cross-sectional dimension >1/2-inch or depth >1/4-inch	Reject product
Class C, non-structural	Chipping and spalling	Gasket groove edges	greatest cross-sectional dimension >1/2-inch or depth >1/4-inch	submit repair
Class D, non-structural		All locations except as noted for Class C	greatest cross-sectional dimension >1-1/2-inch or depth >1/2-inch	submit repair
Class E1, surface irregularities	Local protrusions	joint faces, gasket seating areas	> 1/40-inch	submit repair
Class E2, surface irregularities		All interior surfaces except as noted for Class E1	> 1/4-inch	submit repair
Class F1, surface cracking and crazing	minor non-structural local defects	joint faces, gasket seating areas	> 1/100-inch, any	submit repair
Class F2, surface cracking and crazing		All other areas, except as noted for Class F1	> 1/100-inch, individually assess extent	submit repair
Class G1, structural cracks	Through concrete wall	All locations	any	Reject product
Class G2, structural cracks	Into concrete wall	All locations	> 12-inch and > 1/100-inch	Reject product
Class H, structural damage	Damage exposing reinforcing	All locations	any	submit repair
Class I1 honeycombing	Exposed aggregate, poor consolidation, grout leaks, etc	gasket seating areas	any	submit repair
Class I2, honeycombing		All areas except as noted for Class I1	< 1/4-inch deep or < 1-ft square cumulative area	submit repair

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