



SECTION 1033

PRECAST DRAINAGE UNITS

1033.1 Scope. These specifications cover precast reinforced concrete manhole and drop inlet sections and appurtenances such as grade rings, tops and special sections.

1033.2 Basis of Acceptance. Unless otherwise specified in the contract, acceptance of precast units will be on the basis of tests of material and inspection of the completed product. Acceptability of all types of sections covered by these specifications will be determined by the material tests required in [Sec 1033.3](#); by crushing tests on concrete cores or cured concrete cylinders; by absorption tests on selected samples of concrete from the wall of the sections; and by inspections of the finished sections, including quantity and placement of reinforcement, to determine conformance with these specifications and their freedom from defect. If Class B or B-1 concrete is used, compressive tests and absorption test specimens will not be required.

1033.3 Material.

1033.3.1 Cement. Cement shall conform to the requirements of [Sec 1019](#). Fly ash or GGBFS may be used to replace cement in accordance with [Sec 501](#).

1033.3.2 Fly Ash. Fly ash shall comply with the requirements of [Sec 1018](#).

1033.3.3 Aggregates. Fine and coarse aggregate shall conform to the requirements of [Sec 1005](#), except that requirements for gradation and percent passing the No. 200 (75 μ m) sieve shall not apply.

1033.3.4 Steel Reinforcement. Reinforcement may consist of wire conforming to AASHTO M 32 or AASHTO M 225; or of wire fabric conforming to AASHTO M 55 or AASHTO M 221; or of bars conforming to AASHTO M 31.

1033.3.5 Mixture. The aggregates shall be sized, graded, proportioned and thoroughly mixed in a batch mixer with such proportions of cement and water, as will produce a homogeneous concrete mixture of such quality that the manhole and drop inlet sections will conform to the test and design requirements. Admixtures or blends may be used with the approval of the engineer. In no case, however, shall the proportion of portland cement in the mixture be less than 564 pounds per cubic yard (335 kg/m^3) of concrete. Precast concrete manhole and drop inlet sections may also be constructed of Class B or B-1 concrete. If Class B or B-1 concrete is used, material, proportioning, mixing, slump and transporting of concrete shall be in accordance with [Sec 501](#).

1033.4 Design.

1033.4.1 The minimum compressive strength of the concrete shall be 4000 pounds per square inch (28 MPa). The minimum wall thickness for manhole sections shall be one-twelfth of the internal diameter of the riser or largest cone diameter. Wall thickness for rectangular drop inlets shall be as shown on the plans.

1033.4.2 The circumferential reinforcement in manhole sections may consist of either one or two lines of steel. The total area of reinforcement per vertical or linear foot (meter) shall not be less than 0.0025 times the inside diameter in inches (0.2125 times the inside diameter in millimeters), or in any case, not less than 0.12 square inch per linear foot (255 mm²/m).

1033.4.3 The quantity of steel reinforcement for rectangular drop inlets shall be as shown on the plans.

1033.4.4 Flat slab tops shall be of the thickness shown on the plans and shall be reinforced with a layer of steel with a minimum area of 0.12 square inch per linear foot (255 mm²/m) in both directions. Openings in flat slab tops shall be additionally reinforced with a minimum of the equivalent of 0.20 square inch (133 mm²) of steel at 90 degrees. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus 2 inches (50 mm).

1033.4.5 The circumferential reinforcement in grade rings shall have an equivalent area of not less than 0.07 square inch per linear foot (150 mm²/m), or in any case, not less than 0.024 square inch (15 mm²) in any one grade ring.

1033.5 Modified or Special Designs. The manufacturer may request approval of designs, prior to manufacture, other than those described in these specifications. Special or modified designs shall be submitted to the engineer, in writing and shall fully describe any deviations from these specifications. The description shall also include the wall thickness, all other dimensions, concrete compressive strength and the area, type, placement and strength of the steel reinforcement. Such sections shall meet all of the test and performance requirements specified by the engineer in accordance with [Sec 1033.2](#).

1033.6 Placement of Reinforcement.

1033.6.1 For manholes, if one line of circular reinforcement is used, the reinforcement shall be placed in the center one-third of the wall thickness. If two lines of circular reinforcement are used, each line shall be so placed that the protective covering over the circumferential reinforcement in the wall of the section shall be one inch (25 mm). Either the tongue or groove of the joint shall contain circumferential reinforcement equal in area to that of a single line within the wall of the section. The location of the reinforcement shall be subject, however, to the permissible variations in dimensions specified in [Sec 1033.10.5](#).

1033.6.2 Placement of reinforcement in rectangular drop inlets shall be as shown on the plans.

1033.6.3 In flat slab tops the layers of reinforcement shall be placed near the bottom surface so that the protective cover over the reinforcement shall be one inch (25 mm). The exposure of the ends of the reinforcement will not be a cause for rejection.

1033.6.4 Reinforcement of a given total steel area may be composed of two layers if the layers are not separated by more than the thickness of one cross member plus 1/4 inch (6 mm). The two layers shall be tied together to form a single rigid cage. All other specification requirements such as laps, welds and tolerances of placement in the wall of the manhole, risers and tops, shall apply to this method of fabricating a line of reinforcement.

1033.6.5 Each line of circumferential reinforcement shall be assembled into a cage that shall contain sufficient spacer bars or members, extending through the wall of the manhole risers and conical tops, to maintain the reinforcement rigidly in shape and correct position within the form. The exposure of the ends of stirrups or spacers that have been used to position the cages during the placement of the concrete will not be a cause for rejection.

1033.6.6 If splices are not welded, the reinforcement shall be lapped not less than 20 diameters for deformed bars and 40 diameters for plain bars and cold-drawn wire. The spacing center to center of adjacent rings of circumferential reinforcement in a cage shall not exceed 6 inches (150 mm) for manhole risers and conical tops.

1033.7 Joints. The reinforced concrete riser sections, excepting grade rings, shall be so formed that when the risers and top are assembled they will make a continuous and uniform structure compatible with the tolerance specified in [Sec 1033.10.3](#). The joints shall be of such design as will permit placement without appreciable irregularities in the interior wall surface.

1033.8 Manufacture.

1033.8.1 Placement of Concrete. The transporting and placing of concrete shall be by methods that will prevent the segregation of the concrete material and the displacement of the reinforcing steel from the proper position in the form.

1033.8.2 Curing. Precast units shall be cured in accordance with [Sec 1026](#). Precast sections shall not be transported or erected until the design compressive strength has been reached.

1033.8.2.1 If Class B or B-1 concrete is used, the sections shall be cured with wet burlap for 72 hours or by covering with transparent membrane applied in accordance with the requirements of [Sec 502.12.1](#). Precast units constructed with Class B or B-1 concrete shall not be transported or erected until at least seven days after casting. If forms are removed before the expiration of the curing period, the parts of the structure thus exposed shall be cured as directed by the engineer.

1033.8.3 Lift Holes. Lift holes shall conform to the requirements of [Sec 1026.17](#). Lifting hooks or bars may be cast into the sections, if approved by the engineer.

1033.8.4 Forms. Forms shall be mortar-tight and of sound material adequate to prevent distortion during placing and curing of concrete. Forms shall be reasonably smooth and free of loose knots, holes and other defects.

1033.8.5 Cold Weather Concreting. Concrete placed in cold weather shall be protected from freezing during the curing period by the use of a heated, weatherproof enclosure. Concrete shall not be placed on or against reinforcing steel or other surfaces with temperatures lower than 35 F (2 C). No concrete shall be placed when the ambient temperature is below 35 F (2 C).

1033.9 Physical Test Requirements.

1033.9.1 Concrete Test Requirements. The engineer may require compression test specimens in the quantity of 5 percent of the total number of sections for each contract, but not to exceed two cylinders for each day's production. The specified number of specimens required for the tests shall be furnished without charge by the manufacturer and shall be selected at random by the engineer. If cores are taken for compression tests they shall be from manhole or drop inlet sections that would not otherwise be rejected under this specification. The selection shall be made at the point or points designated by the engineer.

1033.9.2 Compression Tests. Compression tests for satisfying the design concrete strength requirement may be made on either standard rodded concrete cylinders or cylinders compacted and cured in a similar manner to the manhole or drop inlet sections or, at the option of the manufacturer, on cores drilled from the wall of the section. If cylinders are tested, they shall be tested in accordance with the requirements of AASHTO T 22. The average compressive strength of all cylinders tested shall be equal to or greater than the design strength of the

concrete. If compression test cylinders are being used, the manufacturer shall furnish a sufficient number of molds of a type meeting the approval of the engineer. If cores are obtained from the wall of the sections, they shall be cut and tested in accordance with the requirements of AASHTO T 280. The compressive strength of each core tested shall be equal to or greater than the design strength of the concrete. If a core does not meet the required strength, another core from the same section may be tested. If this core does not meet the required strength, that section will be rejected. Additional tests shall be made on other sections to determine the acceptability of the lot. If the cores cut from a section meet the strength test requirement, the core holes shall be plugged and sealed by the manufacturer in a manner such that the section will meet all of the test requirements of this specification. Precast units so sealed shall be considered as satisfactory for use.

1033.9.3 Absorption Test Requirements. The engineer may require samples for absorption tests if concrete other than Class B or B-1 is used. The absorption of a specimen from the wall of a section, as determined in accordance with the requirements of AASHTO T 280 shall not exceed 9 percent of the dry weight (mass). Each sample shall be a piece broken from the wall or a core drilled from the wall, have a minimum area of 9 square inches (5800 mm²) as measured on one surface of the wall, have a thickness equal to the wall and be free of visible cracks. If the initial absorption specimen from a section fails to conform to this specification, the absorption test shall be made on another specimen from the same section and the results of the retest shall be substituted for the original test results.

1033.9.4 Retests. If not more than 20 percent of the concrete test specimens fail to pass the requirements of this specification, the manufacturer may cull stock and may eliminate whatever quantity of sections desired and shall so mark them that they will not be shipped. The required tests will be made on the balance of the order and the sections will be accepted if they conform to the test requirements.

1033.9.5 Test Equipment. Each manufacturer furnishing precast units under these specifications shall furnish all facilities and personnel necessary to carry out the tests described in [Sec 1033.9.2](#) and [1033.9.3](#).

1033.10 Permissible Variations in Dimensions.

1033.10.1 The internal dimensions of precast units shall not vary more than one percent or 3/8 inch (10 mm), whichever is greater.

1033.10.2 The wall thickness shall not be less than that specified in [Sec 1033.4.1](#) or as shown on the plans by more than 5 percent or 3/16 inch (5 mm), whichever is greater. A wall thickness greater than that specified in [Sec 1033.4.1](#) or as shown on the plans will not be cause for rejection.

1033.10.3 Variations in lengths of two opposite sides of precast units shall not be more than 5/8 inch (16 mm).

1033.10.4 The vertical spacing and vertical alignment between adjacent manhole steps and horizontal distance from the inside wall to the centerline of a manhole step shall not vary more than one inch (25 mm) from the design dimensions.

1033.10.5 Position and Area of Reinforcement.

1033.10.5.1 Position. For sections with a 4-inch (100 mm) thickness or less, the maximum variation in the position of the reinforcement from that specified in [Sec 1033.6](#) shall be 10 percent of the thickness or 1/4 inch (6 mm), whichever is the greater. For sections with a thickness greater than 4 inches (100 mm) the maximum variation shall be 10 percent of the

thickness or 5/8 inch (16 mm), whichever is the lesser. The cover over the reinforcement shall not be less than 3/4 inch (19 mm).

1033.10.5.2 Area. Steel areas up to 0.005 square inch per linear foot (10 mm²/m) less than that specified will be considered as meeting the required steel area.

1033.11 Steps. Steps for precast manholes and drop inlets shall be in accordance with [Sec 604.10](#) and as shown on the plans. Steps in riser and conical top sections shall be aligned in each section so as to form a continuous ladder with rungs equally spaced vertically in the assembled manhole at a maximum distance of 16 inches (400 mm). Steps shall be embedded in the riser or conical top section wall a minimum distance of 3 inches (75 mm). The rung or cleat shall project a minimum clear distance of 4 inches (100 mm) from the wall of the riser or cone section measured from the point of embedment.

1033.12 Finish. Precast units shall be substantially free of fractures, large or deep cracks and surface roughness. The planes of the ends of the sections shall be perpendicular to their longitudinal axis, within the limits of the variations specified in [Sec 1033.10.3](#).

1033.13 Repairs. Precast units may be repaired, if necessary, because of occasional imperfections in manufacture or accidental injury during handling and will be acceptable if, in the judgment of the engineer, the repairs are sound, properly finished and cured and the repaired manhole sections conform to the requirements of these specifications. Filling of form tie cavities and repair of other defects shall be in accordance with [Sec 703.3.15](#).

1033.14 Inspection and Rejection.

1033.14.1 Inspection. The quality of material, the process of manufacture and the finished precast units shall be subject to inspection and approval by the engineer.

1033.14.2 Rejection. Precast units shall be subject to rejection for failure to conform to any of the specified requirements. In addition, individual sections may be rejected because of any of the following:

- (a) Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
- (b) Defects that indicate imperfect proportioning, mixing and molding.
- (c) Surface defects indicating honeycombed or open texture.
- (d) Damaged or cracked ends where such damage would prevent making a satisfactory joint.
- (e) Any continuous crack having a surface width of 0.01 inch (0.3 mm) or more and extending for a length of 12 inches (300 mm) or more, regardless of position in the section wall.

1033.15 Marking. The following information shall be clearly marked on the inside of each precast unit:

- (a) MH for manholes or DI for drop inlets. Other units do not need a designation.
- (b) Date of manufacture.
- (c) Name or trademark of the manufacturer.

Marking shall be indented into the section or shall be painted thereon with waterproof paint.