
USACE / NAVFAC / AFCEA UFGS-02582 (August 2004)

Preparing Activity: NAVFAC Superseding
UFGS-02582N (February 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags.

SECTION 02582

ELECTRICAL MANHOLE AND HANDHOLE 08/04

NOTE: This guide specification covers the requirements for electrical manhole, handhole and accessories, for providing electrical underground facilities.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

NOTE: INSTRUCTIONS TO VIEW/PRINT GRAPHICS

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NOTE: The following information shall be shown on the project drawings:

1. Where specification identifies type, size, or other definitive information to be "as indicated," the engineer shall include the information on the drawings.

2. Location of manholes, and handholes.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318M/318RM (2002) Metric Building Code Requirements for Structural Concrete and Commentary

ACI SP-66 (1994) ACI Detailing Manual

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17 (2002) Standard Specifications for Highway Bridges

AASHTO M 198 (2003) Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2 (1997) National Electrical Safety Code

ASTM INTERNATIONAL (ASTM)

ASTM C 139 (2003) Concrete Masonry Units for Construction of Catch Basins and Manholes

ASTM C 260 (2001) Air-Entraining Admixtures for Concrete

ASTM C 309 (2003) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 32 (1993; R 1999e1) Sewer and Manhole Brick

(Made from Clay or Shale)

ASTM C 478 (2003) Precast Reinforced Concrete Manhole Sections

ASTM C 478M (2003) Precast Reinforced Concrete Manhole Sections (Metric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-621 (Rev E; Notice 1) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.2 RELATED REQUIREMENTS

Section 16302N UNDERGROUND TRANSMISSION AND DISTRIBUTION and Section 16522N AIRFIELD LIGHTING apply to this section with additions and modifications specified herein.

1.3 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

NOTE: Submittals are required for each kind, voltage, or type used on the project. Delete item (c), "Proposed precast sectional underground ductbank" for LANTNAVFACENGCOM projects.

Cast-In-Place [manholes] [handholes]

Precast [manhole] [and] [handhole]; G, [_____]

Pulling-in irons; G, [_____]

SD-03 Product Data

Precast concrete structures; G, [_____]

[Manhole] [and] [Handhole] Frames and covers; G, [_____]

Sealing material for precast manhole and handhole joints; G, [_____]

Cable racks, arms and insulators; G, [_____]

1.4 QUALITY ASSURANCE

1.4.1 Precast [Manhole] [and] [Handhole]

Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

- a. Material description (i.e., f'c and Fy)
- b. Manufacturer's printed assembly and installation instructions
- c. Design calculations
- d. Reinforcing shop drawings prepared in accordance with ACI SP-66.
- e. Plans and elevations showing opening and pulling-in iron locations and details.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Underground Structures

NOTE: Use steel frames only in high impact areas such as airport runways. Edit paragraph to comply with project requirements concerning the type of structure, strength of concrete, concrete mix, metal accessories, and excavating and grading. Indicate special reinforcing where required. Designer shall contact local telephone company, where applicable, concerning the size of all signal manholes and the number and type of signal duct required. Determine availability since H2O loadings may not be available in precast. See standard sketches 1 through 4 attached hereto, covering manholes and handholes. The required sketches should be included on the project drawings.

[2.1.1.1 Cast-In-Place Concrete Manholes

Smooth trowel finish for floors and horizontal surfaces. Concrete shall conform to Section 03300N CAST-IN-PLACE CONCRETE. [Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers]. [Concrete block shall conform to ASTM C 139 and Section 04200 UNIT MASONRY]

] [2.1.1.2 Precast Concrete Manholes, Risers and Tops

ASTM C 478MASTM C 478 [, except that the spacing of manhole steps or ladder rungs shall not exceed 405 mm 16 inches]. [Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete manholes and handholes].

] 2.1.1.3 [Manholes] [and] [Handholes]

Provide type indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers shall fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cast the words "ELECTRIC" and "TELEPHONE" in the top face of power and telephone manhole covers, respectively. Cable racks, including rack arms and insulators, shall be adequate to accommodate the cable.

[2.1.1.4 Metal Frames and Covers

NOTE: Use steel frames only in high impact areas such as airport runways.

Provide cast iron frames and covers for manholes conforming to FS RR-F-621.
Provide steel frames and covers of rolled steel floor plate for handholes.

]2.1.1.5 Drainage Pipe and Fittings

NOTE: Delete this paragraph for LANTNAVFACENGCOM projects.

Cast-iron, extra strength. Drains shall be cast-iron, coated or uncoated, plain pattern, bottom outlet with perforated or slotted hinged cover.

[2.1.1.6 Fiberglass Handholes

Shall be matched die molded of dark green fiberglass with approximate dimensions of 810 mm 32 inches high, top surface of 1090 by 950 mm 43 by 37 1/2 inches, and top opening of 810 by 660 mm 32 by 26 inches. When buried, the unit shall be capable of supporting an ultimate downward load of 2955 kg 6500 pounds distributed over a 150 by 150 mm 6 by 6 inch area imposed anywhere on the cover surface (H10 loading per AASHTO HB-17). Unit shall have precut 150 by 150 mm 6 by 6 inch cable entrance at the center bottom of each side. A fiberglass weatherproof cover with nonskid surface shall be provided for each handhole. Covers shall be capable of being locked into position.

] [2.1.1.7 Brick for Manhole Collar

NOTE: Use this paragraph for LANTNAVFACENGCOM projects only. Do not use brick for manholes in Iceland.

Brick shall be sewer and manhole brick conforming to ASTM C 32, Grade MS.

]2.1.2 Cable Racks, Arms and Insulators

Metal portion of racks and arms shall be zinc-coated after fabrication.

2.1.2.1 Cable Racks

Wall bracket shall be 100 mm 4 inches by approximately 38 by 4.76 by 1220-mm 1-1/2 by 3/16 by 48 inches long (minimum) channel steel. Slots for mounting cable rack arms shall be spaced at 200 mm 8 inch intervals.

2.1.2.2 Rack Arms

Cable rack arms shall be steel or malleable iron or glass reinforced nylon and shall be of the removable type.

2.1.2.3 Insulators

Insulators for metal rack arms shall be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.1.3 Cast-In-Place [Manholes] [Handholes]

NOTE: Use this paragraph and its subparagraphs for specification covering work under SOUTHNAVFACENGCOM cognizance in lieu of the above paragraphs, starting from the paragraph entitled "Underground Structures."

NOTE: See sketches attached at end of this guide for Manhole and Handhole details. Put the appropriate details on the drawings, modify as necessary for the project. DO NOT INCLUDE SKETCHES AS PART OF PROJECT SPECIFICATIONS.

Cast-in-place reinforced concrete [manholes] [handholes] shall be as indicated. Floor surfaces shall have a steel trowel finish. The complete [manholes] [handholes] shall be rated for [nontraffic] [AASHTO H 20] [_____] wheel loading per AASHTO HB-17. Covers shall fit frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from warp and blow holes that may impair strength or appearance. Exposed metal shall have smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. The words "electric" and "telephone" shall be cast in the top face of power and telephone [manhole] [handhole] covers, respectively.

2.1.3.1 Optional Precast Concrete Construction

In lieu of cast-in-place concrete [manholes] [and] [handholes], the Contractor may, provide precast concrete structures, subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

- a. General: Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work shall have an ultimate 28-day compressive strength of not less than 30 MPa 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.
- b. Construction structure top, bottom, and wall shall be of a uniform thickness of not less than 150 mm 6 inches. Thin-walled knock-out panels designed for future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the

precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 305 mm 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows shall be a minimum of 150 mm 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. The minimum concrete cover for reinforcing steel shall be 50 mm 2 inches. Provide drain sumps for precast structures a minimum of 305 mm 12 inches in diameter and 100 mm 4 inches deep.

- c. Joints: Provide tongue-and-groove or shiplap joints on mating edges of precast components. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.1.3.2 Metal Frames and Covers

Shall be made of [cast iron] [steel]. [Cast-iron frames and covers shall meet FS RR-F-621.] [Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled steel floor plate having an approved antislip surface.] Covers shall be rated [AASHTO H 20] [_____].

2.1.3.3 Pulling-In Irons

Shall be steel bars bent in the form indicated and cast in the walls and floors. In the floor they shall be centered under the cover and in the wall they shall be not less than 150 mm 6 inches above or below, and opposite the conduits entering the manhole. Pulling-in irons shall project into the manhole approximately 100 mm 4 inches. Iron shall be hot-dipped galvanized after fabrication.

2.1.3.4 Cable Racks

Including rack arms and insulators, shall be sufficient to accommodate the cables. Racks in power manholes shall be spaced not more than 1215 mm 3 feet apart, and each manhole wall shall be provided with a minimum of two racks. Racks in signal manholes shall be spaced no more than 415 mm 16 1/2 inches apart with the end rack being no further than 305 mm 12 inches from the adjacent wall. The wall bracket shall be channel steel. Slots for mounting cable rack arms shall be spaced at 200 mm 8 inch intervals. The cable rack arms shall be of steel or malleable iron and shall be of the removable type. Insulators shall be dry-process glazed porcelain. The metal portion of racks shall be hot-dip galvanized after fabrication.

2.1.3.5 Grounding in [Manholes] [Handholes]

Provide No. 6 AWG bare copper grounding pigtails on walls of each [manhole]

[handhole]. The pigtails shall be exothermically welded to the reinforcing bars and shall extend at least 200 mm 8 inches into [manhole] [handhole]. Two pigtails shall be provided in each [manhole] [handhole].

2.1.3.6 Precast [Manholes] [Handholes] Installation

Commercial precast assembly shall be set on 150 mm 6 inches of level, 90 percent compacted granular fill, 19 mm to 25 mm 3/4 inch to one-inch size, extending 305 mm 12 inches beyond the [manhole] [handhole] on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.

2.1.3.7 Field Painting

[Cast-iron frames and covers not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.] [Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be coated with a pretreatment coating or be given a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be primed with a coat of primer and one coat of synthetic exterior gloss enamel.]

PART 3 EXECUTION

3.1 INSTALLATION

NOTE: Soil treatment for termite control shall conform to Section 02361, "Soil Treatment for Termite Control," except that application to direct burial cable installation shall be as specified. In lieu of soil poisoning, cable in direct-buried EPC-40-PVC conduit can be a more economical and practical way of protecting cable from termites.

NOTE: CALPUC publication applies only to State of California Public Utilities Commission CALPUC G.O.128, "Construction of Underground Electric Supply and Communication System" for underground electrical work. For other states, delete this publication and insert other publications which govern underground electrical work for that state. Revise reference paragraph to include deletion or addition of state publication.

[NFPA 70] and [ANSI C2] [and CALPUC G.O.128].

3.1.1 Contractor Damage

NOTE: Use this paragraph for LANTNAVFACENGCOM

projects only.

The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Contracting Officer of any such damage.

3.1.2 Concrete

NOTE: Use first bracketed paragraph when project includes a concrete section in Division 03; otherwise, second bracketed paragraph may be used.

[Concrete work for electrical requirements shall be 20 MPa 3000 psiminimum ultimate 28-day compressive strength with 25-mm one-inchminimum aggregate conforming to the requirements of Section [03300N CAST-IN-PLACE CONCRETE].]

NOTE: If concrete requirements are detailed and no cast-in-place concrete section is to be included in the project specification, refer to Section 03300, "Cast-In-Place Concrete" and select such portions needed to provide complete requirements.

[Shall be composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be reasonably well graded from 4.75 mm to 25 mm 3/16 inch to one inch. The fine and coarse aggregates shall be free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete shall have a compressive strength of [20] [30] MPa [3000] [4000] psi at the age of 28 days. Slump shall not exceed [75] [100] mm [3] [4] inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer. Air entrain concrete exposed to weather using and air-entraining admixture conforming to ASTM C 260. Air content shall be between 4 and 6 percent.]

3.1.3 Cast-In-Place [Manholes] [and] [Handholes]

NOTE: Edit the paragraph to comply with project requirements concerning the type of structure or duct, strength of concrete, concrete mix, metal accessories, and excavating and grading. See

standard sketches 1 through 6 attached hereto,
covering manholes and handholes. Use sketches 5 and
6 for airfield areas. The required sketches should
be included on the project drawings.

Underground structure shall be cast in place or may be of precast construction as specified herein. Horizontal concrete surfaces of floors shall have a smooth finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound shall conform to ASTM C 309. [Cast-in-place handholes shall be standard type [_____] as indicated] [on Sketch No. ____]. [Cast-in-place manholes shall be standard type [_____] as indicated] [on Sketch No. ____]. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures shall fit the frames without undue play. Steel and iron shall be formed to shape and size with sharp lines and angles. Castings shall be free from wrap and blow holes that may impair strength or appearance. Exposed metal shall have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. The words "Electric" and "Telephone" shall be cast in the top face of power and telephone manhole covers, respectively.

[3.1.3.1 AIRFIELD [MANHOLES] [AND] [HANDHOLES]

Provide electrical [manholes] [and] [handholes] designed for a maximum single wheel load of 22 700 kg 50,000 lb or dual wheel load of 40 860 kg 90,000 lb.

]3.1.4 Optional Precast Concrete Construction

**NOTE: Use the following paragraph and its
subparagraphs for LANTNAVFACENGCOM projects only.**

3.1.4.1 Optional Precast Concrete Construction

In lieu of cast-in-place, the Contractor may, at his option, provide precast concrete [manholes] [and] [handholes], subject to the requirements specified below. Precast units shall be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes and handholes.

- a. General: Precast concrete structures shall have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures shall have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction shall be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. concrete for precast work shall have an ultimate 28-day compressive strength of not less than 30 MPa 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections,

designed and produced by the manufacturer in accordance with the requirements specified. Structures shall be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

- b. Design for precast structures: ACI 318M/318RM. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

(1) Angle of internal friction (ϕ): 0.523 rad 30 degrees

(2) Unit weight of soil (dry): 1760 kg/m³ 110 pcf, (saturated): 2080 kg/m³ 130 pcf

(3) Coefficient of lateral earth pressure (K_a) = 0.33

(4) Ground water level: 915 mm 3 feet below ground elevation

(5) Vertical design loads shall include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads shall consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. Minimum design vertical load shall be for H20 highway loading per AASHTO HB-17.

(6) Horizontal design loads shall include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, shall be considered along with a pulling-in iron design load of 26 700 N 6000 pounds.

(7) Each structural component shall be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

(8) Design shall also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

- c. Construction: Structure top, bottom, and wall shall be of a uniform thickness of not less than 150 mm 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances shall not be permitted. Quantity, size, and location of duct bank entrance windows shall be as directed, and cast completely open by the precaster. Size of windows shall exceed the nominal duct bank envelope dimensions by at least 305 mm 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct misalignment. However, the sides of precast windows shall be a minimum of 150 mm 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. [Minimum concrete

cover for reinforcing steel shall be 50 mm 2 inches.] Provide drain sumps for precast structures a minimum of 305 mm 12 inches in diameter and 100 mm 4 inches deep.

**NOTE: Do not use shiplap joints for
LANTNAVFACENGCOM projects.**

- d. Joints: Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to AASHTO M 198, Type B. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

3.1.4.2 Metal Frames and Covers for Handholes

Frames and covers of steel shall be welded by qualified welders in accordance with standard commercial practice. Steel covers shall be rolled-steel floor plate having an approved antislip surface. Hinges shall be of [galvanized steel with bronze hinge pin] [wrought steel], 125 by 125 mm 5 by 5 inches by approximately 4.75 mm 3/16-inchthick, without screw holes, and shall be for full surface application by fillet welding. Hinges shall have nonremovable pins and five knuckles. Surfaces of plates under hinges shall be true after the removal of raised antislip surface, by grinding or other approved method.

3.1.4.3 Pulling-In Irons

Pulling-in irons shall be steel bars bent as indicated [by Sketch No. 16375-4,] and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. Final installation of pulling-in devices shall be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons shall be a minimum of 150 mm 6 inches from the edge of the sump, and in the walls the irons shall be located within 150 mm 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron shall not be located within 150 mm 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 150 mm 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 915 mm 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner shall be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 75 mm 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons shall have a clear projection into the structure of

approximately 100 mm 4 inches and shall be designed to withstand a minimum pulling-in load of 26 700 N 6000 pounds. Irons shall be [hot-dipped galvanized] [zinc-coated] after fabrication.

3.1.4.4 Cable Racks

Cable racks, arm and insulators shall be sufficient to accommodate the cables. Racks in power manholes [and handholes] shall be spaced not more than 915 mm 3 feet apart, and each manhole [and handhole] wall shall be provided with a minimum of two racks. Racks in signal manholes [and handholes] shall be spaced not more than 420 mm 16 1/2 inches apart with the end rack being no further than 305 mm 12 inches from the adjacent wall. [Rack arm length shall be a minimum of 200 mm 8 inches and a maximum of 305 mm 12 inches.] Methods of anchoring cable racks shall be as follows:

- a. Provide a 15.8 mm diameter by 125 mm 5/8 inch diameter by 5-inch long anchor bolt with 75 mm 3-inch foot cast in structure wall with 50 mm 2 inch protrusion of threaded portion of bolt into structure. Provide 15.87-mm 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with white lead immediately prior to installing nuts.
- b. Provide concrete channel insert with a minimum load rating of 1192 kg/m 800 pounds per foot. Insert channel shall be steel of the same length as "vertical rack channel;" channel insert shall be cast flush in structure wall. Provide 15.87 mm 5/8 inch steel nuts in channel insert type receive 15.87 mm diameter by 75 mm 5/8 inch diameter by 3 inch long steel, square head anchor bolts.
- c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert shall have minimum 365 kg 800 pound load rating. Provide 15.87 mm diameter by 75 mm 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with white lead immediately prior to installing bolts.

3.1.4.5 Grounding in [Manholes] [Handholes]

Provide a No. 1/0 AWG bare copper cable on each [manhole] [and] [handhole] sidewall. The cables shall be exothermically welded to the ground rod in the [manhole] [and] [handhole], and shall be accessible for future grounding requirements.

3.1.4.6 [Precast] [Manholes] [Fiberglass] [Handholes] Installation

[Commercial [precast] [fiberglass] assembly shall be set on 150 mm 6 inches of level, 90 percent compacted granular fill, 19 to 25 mm 3/4 to one inch size, extending 305 mm 12 inches beyond the [manhole] [handhole] on each side. Granular fill shall be compacted by a minimum of four passes with a plate type vibrator.] [Installation shall conform to the manufacturer's instructions.]

3.1.4.7 Field Painting

[Cast-iron frames and covers not buried in masonry shall be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.] [Steel frames not buried in masonry and steel covers shall be cleaned of mortar, dirt and grease by an approved blasting process. Surfaces that cannot be cleaned satisfactorily by blasting shall

be cleaned to bare metal by wire brushing or other mechanical means. Surfaces contaminated with rust, dirt, oil, grease, or other contaminants shall be washed with solvents until thoroughly cleaned. Immediately after cleaning, surfaces shall be given a crystalline phosphate coating. As soon as practicable after the pretreatment coating has dried, treated surfaces shall be primed with a coat of zinc-molybdate primer and one coat of synthetic exterior gloss enamel.] [Primer and paint shall be as specified in Section 09900 PAINTS AND COATINGS.]

3.1.5 Earthwork for Utilities

Section 02300 EXCAVATION.

-- End of Section --