

\*\*\*\*\*  
NAVFAC IGS-16721 (MARCH 2003)  
-----  
Supercedes IGS-16721 (05/02)  
Preparing Activity: LANTNAVFACENGCOM Based on UFGS-16721N

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

\*\*\*\*\*

SECTION 16721

TELEPHONE DISTRIBUTION SYSTEM, OUTSIDE PLANT  
03/03

\*\*\*\*\*

NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

\*\*\*\*\*

\*\*\*\*\*

NOTE: This guide specification covers exterior telephone distribution system consisting of main distribution frame, outside cable, and associated hardware. This guide specification is to be used in the preparation of project specification.

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

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: This section will be used in conjunction with any other guide specifications required by the design. Show following information on project drawings:

1. Where specification identifies type, size, color, finish, or other definitive information to be "as indicated" the engineer shall show the information on the drawings.
2. Location of manholes, handholes, ducts, and

cables.

3. Types of wire and cable; number and sizes of conductors and conduits.

4. Special conditions.

5. Include tensioning and sag data on drawings in tabular form for aerial cable installation.

\*\*\*\*\*

PART 1 GENERAL

1.1 REFERENCES

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

EUROPEAN COMMUNITY QUALITY MARKS (CE)

\*\*\*\*\*

NOTE: CE (European Community) is a European quality marking system indicating that the equipment or product conforms to EEC (European Economic Community) standards concerning quality of safety and health and conforms with all the Italian technical standards in force. All products (Electrical, Mechanical and Electronic Equipment and similar items) that are marked CE conform to the standards and Laws enforced in Europe. In Italy, the CE marking is a mandatory requirement and must be shown on all applicable equipment and products attesting to the conformity with the EEC standards.

\*\*\*\*\*

CE European Quality Mark

ITALIAN ELECTROTECHNICAL COMMITTEE (CEI)

\*\*\*\*\*

NOTE: A CEI Norm is an Italian technical normative for electrical systems recognized by Italian Law, submitted by a private organization "Comitato Elettrotecnico Italiano" for the Italian territory, available in the Italian language and only in some cases in English.

\*\*\*\*\*

CEI 20-22/2 (1999) Tests on electric cables under fire conditions - Part 2: Fire propagation

CEI 64-8 (1998) Electrical installations of

buildings

CEI 103-1/12

(1997) Private telephone exchanges - Part 12: Protection of the private telephone exchanges

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)  
(UNI EN ISO)(UNI ISO)

\*\*\*\*\*

**NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.**

\*\*\*\*\*

CEI EN 50086-1

(1997) Conduit systems for electrical installations - Part 1: General requirements

CEI EN 50086-2-4

(1997) Conduit systems for electrical installations - Part 2-4: Particular requirements for conduit systems buried underground

CEI EN 60529

(1997) Degrees of protection provided by enclosures (IP Code)

1.2 RELATED REQUIREMENTS

\*\*\*\*\*

**NOTE: Coordinate with Sections 16303, "Underground Electrical Work" and 16301, "Overhead Transmission and Distribution."**

\*\*\*\*\*

Section 16050, "Basic Electrical Materials and Methods" applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

\*\*\*\*\*

**NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significant to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.**

\*\*\*\*\*

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Telephone distribution system; G

SD-03 Product Data

Wire and cable; G

Cable splices, and connectors; G

Closures; G

Cross-connect terminal cabinets; G

Fiberglass enclosure; G

For fiberglass enclosure, include full documentation citing conformance to structural parameters.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

SD-07 Certificates

Cable splicer's qualifications; G

SD-08 Manufacturer's Instructions

Installation procedures; G

1.4 QUALITY ASSURANCE

1.4.1 Telephone Distribution System

Submit shop drawing complete with wiring and schematic diagrams and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for operations and maintenance. System drawings shall show final configuration, including location, size, pair, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector blocks layout at termination points after installation.

1.4.2 Cable Splicer's Qualifications

Submit for approval, 30 days before splices are to be made on the cable. Certification shall include the training, and experience of the individual on specific type and classification of cable to be provided under this contract.

#### 1.4.3 Installation Procedures

Where installation procedures, or any part thereof, are required to be in accordance with manufacturer's instructions, submit these instructions to the Contracting Officer prior to installation of the equipment.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in [\_\_\_\_\_] meter length with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants.

### PART 2 PRODUCTS

#### 2.1 SOURCE MANUFACTURERS

##### 2.1.1 Distribution Frame

The following manufacturers provide distribution frames and fiber optic patch panels that generally comply with these specifications:

Quante Trucco S.p.A.  
A 3M Company  
Via della Liberazione, 1  
20068 Peschiera Borromeo (MI)  
Tel: 02/553621  
Fax: 02/55306967  
www.quante.com

KRONE ITALIA  
Via Padre G.A. Filippini, 119  
00144 Roma  
Tel: 06/52201260  
Fax: 06/52201259  
www.krone.it

##### 2.1.2 Closures

The following manufacturers provide distribution system component closures that generally comply with these specifications:

Quante Trucco S.p.A.  
A 3M Company  
Via della Liberazione, 1  
20068 Peschiera Borromeo (MI)  
Tel: 02/553621  
Fax: 02/55306967  
www.quante.com

O. De Nicolai  
Via Vallarsa, 10  
20139 Milano  
Tel: 02/5691013  
Fax: 02/57400050  
www.denicolai.it

#### 2.1.3 Pad Mounted Cross-Connect Terminal Cabinets

The following manufacturers provide pad mounted cross-connect terminal cabinets that generally comply with these specifications:

Quante Trucco S.p.A.  
A 3M Company  
Via della Liberazione, 1  
20068 Peschiera Borromeo (MI)  
Tel: 02/553621  
Fax: 02/55306967  
www.quante.com

O. De Nicolai  
Via Vallarsa, 10  
20139 Milano  
Tel: 02/5691013  
Fax: 02/57400050  
www.denicolai.it

#### 2.1.4 Cable Splices and Connectors

The following manufacturers provide cable splicing and connector materials that generally comply with these specifications:

Quante Trucco S.p.A.  
A 3M Company  
Via della Liberazione, 1  
20068 Peschiera Borromeo (MI)  
Tel: 02/553621  
Fax: 02/55306967  
www.quante.com

O. De Nicolai  
Via Vallarsa, 10  
20139 Milano

Tel: 02/5691013  
Fax: 02/57400050  
www.denicolai.it

#### 2.1.5 Conduit

The following manufacturers provide electrical conduit that generally comply with these specifications:

DIELECTRIX ITALIA  
Via E. Pavese, 53  
29015 Castel San Giovanni (PC)  
Tel: 0523/882241  
Fax: 0523/881270

RICCINI S.r.l.  
Strada Tiberina Nord, 28/A  
06077 Ponte Felcino (PG)  
Tel: 075/5917010  
Fax: 075/5917020  
www.riccini.it

#### 2.1.6 Plastic Insulating Tape

The following manufacturers provide plastic insulating tape materials that generally comply with these specifications:

DIELETTTRICA LIGURE S.r.l.  
Via Pergola, 17  
16039 Sestri Levante (GE)  
Tel: 0185/43095  
Fax: 0185/456966  
www.dielettricaligure.it

FACOT CHEMICALS S.r.l.  
Via Crema, 44  
26010 Capralba (CR)  
Tel: 0373/450642  
Fax: 0373/450751  
www.facot.it

#### 2.1.7 Wire and Cable

The following manufacturers provide electrical wire and cable for telephone distribution systems that generally comply with these specifications:

PIRELLI CAVI E SISTEMI S.p.A.  
Viale Sarca, 222 - 20126 Milano  
Tel: 02-6442-1  
Fax: 02-6442-9264  
cables-it.gw@pirelli.com  
www.it.pirelli.com/cables  
www.pirelli.com

ROSSYSTEMS  
Via San Lorenzo, 23  
Bari  
Tel: 080/5575566  
Fax: 080/5566860  
www.rossystems.com

#### 2.1.8 Enclosures

The following manufacturers provide fiberglass enclosures and non-galvanized enclosures for telephone distribution system components that generally comply with these specifications:

CONCHIGLIA S.p.A.  
Via Coralli, 5  
42100 Reggio Emilia  
Tel: 0522/387211  
Fax: 0522/302803  
www.conchiglia.com

N.T.ET  
Viale Gran Sasso, 7  
20131 Milano  
Tel: 02/29531559  
Fax: 02/29531560

#### 2.1.9 Miscellaneous Items

The following manufacturers provide miscellaneous items such as cable tags, warning and identification tape and grounding braid for telephone distribution systems that generally comply with these specifications:

COREX  
Via San Giacomo, 8  
10092 Beinasco (TO)  
Tel: 011/3497796  
Fax: 011/3971436  
www.corex.it

FACOT CHEMICALS S.r.l.  
Via Crema, 44  
26010 Capralba (CR)  
Tel: 0373/450642  
Fax: 0373/450751  
www.facot.it

LEGRAND ITALIA  
20080 Zibido San Giacomo (MI)  
S.S. 35 dei Giovi Km 108  
Tel: 02/900281  
Fax: 02/90028688  
www.legrand.it

O. De Nicolai

Via Vallarsa, 10  
20139 Milano  
Tel: 02/5691013  
Fax: 02/57400050  
www.denicolai.it

## 2.2 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturer of such products and shall be the manufacturer's latest standard design.

## 2.3 DISTRIBUTION FRAME

### 2.3.1 Main Distribution Frame (MDF), For Copper Conductors

IP54 [\_\_\_\_] as per CEI EN 60529, modular type steel or fiberglass reinforced resin construction and treated to resist corrosion.

#### 2.3.1.1 Connector Blocks

Main frame connector blocks consisting of flame-retardant molded plastic fastened to a metal mounting bar, to terminate [\_\_\_\_] pairs of outside cable. Connector blocks shall be of the size which are able to terminate and protect at least [\_\_\_\_] pairs, per vertical, on a 2200 mm high MDF. Connector blocks shall be of 100 pair block size and equipped with protection modules.

#### 2.3.1.2 Protector Modules

CEI 103-1/12, solid state type rated for the application.

### 2.3.2 Building Distribution Frame (BDF), For Copper Conductor

Consist of a self-contained [wall mounted] [single sided floor mounted] [double sided floor mounted] unit providing a field cable stub, housing for termination and protector modules, and access for cross-connecting to interior telephone wiring.

### 2.3.3 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of fiber optic cables. Panel shall be constructed of [\_\_\_\_] mm minimum [steel] [aluminum] and have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable. Panels shall be equipped with engraved laminated plastic nameplates above each connector.

## 2.4 CLOSURES

### 2.4.1 Copper Conductor Closures

#### 2.4.1.2 Underground Cable Closures

\*\*\*\*\*

**NOTE: Indicate sizes on drawings.**

\*\*\*\*\*

- a. Aboveground: Constructed of [not less than 1.8 mm steel] [fiberglass] and acceptable for [pole] [stake] mounting. Closures shall be sized as indicated. Covers shall contain a marker as indicated and shall be secured to prevent unauthorized entry.
- b. Direct burial: Buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity in the buried environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.
- c. In vault or manhole: Underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

#### 2.4.2 Fiber Optic Closures

Provide closures in accordance with Section 16713, "Fiber Optic (FO) Outside Plant (OSP) Media." and the following:

##### 2.4.2.1 Direct Burial

Buried closure suitable to house splicer organizer in protective housing into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried environment. Encapsulating compound shall be reenterable and shall not alter chemical stability of the closure.

##### 2.4.2.2 In Vault or Manhole

Underground closure suitable to house splicer organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

#### 2.5 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS

\*\*\*\*\*

**NOTE: Indicate size on the drawing.**

\*\*\*\*\*

Comply with [IP43] [IP54] [\_\_\_\_] as per CEI EN 60529.

- a. Constructed of [plastic] [1.8 mm steel] [or] [\_\_\_\_\_].
- b. Equipped with a double set of hinged doors with closed-cell foam weatherstripping. Doors shall be locked and contain a marker as indicated.
- c. Equipped with spool spindle bracket, mounting frames, binding post log, and jumpering instruction label.
- d. Complete with cross connect modules.
- e. Sized as indicated.

## 2.6 CABLE SPLICES, AND CONNECTORS

### 2.6.1 Copper Cable Splices

Splices shall consist of a moisture resistant, [two-wire] [three-wire] [10 pair] [25 pair] connector held rigidly in place to assure maximum continuity. Provide correct connector size to accommodate the cable size of the supplied cable. Connector shall be of the type in accordance with the cable manufacturer's instructions.

### 2.6.2 Fiber Optic Cable Splices

Provide splices in accordance with Section 16713, "Fiber Optic (FO) Outside Plant (OSP) Media."

### 2.6.3 Connector

Splice connectors shall have polycarbonate body and cap with a tin-plated brass contact element. Connector shall accommodate 0.4 to 0.9 mm diameter solid wire with a maximum insulation diameter of 1.5 mm. Fill connector with sealant grease to make a moisture resistant connection.

### 2.6.4 Shield Connectors

Connectors shall make a stable, low-impedance electrical connection between the cable shield and the bonding conductor.

## 2.7 CONDUIT

\*\*\*\*\*  
**NOTE: When referring to Section 16303, "Underground Electrical Work" for conduit installation, delete this paragraph.**  
\*\*\*\*\*

Plastic conduit shall be PVC and shall conform to CEI EN 50086-1 and CEI EN 50086-2-4 for direct buried conduit, and CEI EN 50086-1 for concrete encased conduit. Fittings shall conform to CEI EN 50086-1 and CEI EN

50086-2-4.

## 2.8 PLASTIC INSULATING TAPE

CE listed.

## 2.9 WIRE AND CABLE

### 2.9.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Size: [\_\_\_\_]. Copper conductor shall conform to the following:

#### 2.9.1.1 Underground

Provide gel filled cable. Gel shall be petroleum jelly to provide a [moisture resistant] [waterproof] cable.

#### 2.9.1.2 Screen

Screen-compartmental core cable shall be gel filled cable.

### 2.9.2 Fiber Optic Cable

Provide optical fibers in accordance with Section 16713, "Fiber Optic (FO) Outside Plant (OSP) Media."

### 2.9.3 Grounding and Bonding Conductors

CEI 64-8, solid bare copper wire for sizes 10 sq. mm and smaller; and stranded bare copper wire for size 16 sq. mm and larger. Insulated conductors shall have 450-volt PVC insulation, type N07V-K meeting the requirements of CEI 20-22/2.

## 2.10 FIBERGLASS ENCLOSURE

### 2.10.1 Materials

Provide fiberglass enclosure made of the following raw materials:

- a. Resins: Thermosetting, medium reactivity, rigid fire resistant polyester.
- b. Glass fiber: Reinforcement shall be borosilicate glass having high performance chrome-complex or silane finish compatible with polyester resin.

- c. Gelcoat: Exterior surface coating shall be ultraviolet light stabilized, weather resistant, polyester base containing fade resistant color pigments and such inert extenders as are appropriate to maintain total pigment volume concentration less than 20 percent. Finish color shall be the manufacturer's standard.
- d. Interior coating: Interior laminate coating when required shall be pigmented, heat resistant, high gloss, polyester base, and surfacing sealer.

2.10.2 Structural Parameters

Enclosure shall meet or exceed the following structural parameters:

	<u>Minimum</u>	<u>Maximum</u>
Tensile Strength,	56.36	120.5 MPa
Flexural Properties,	41.61	86.13 MPa
Tangent Modulus of Elasticity,	2806.3	3122.55 MPa
Compressive Strength,	133.32	186 MPa
Water Absorption,		0.5 percent
Charpy Impact Test,	4.08	5.44 N.m
Impact Resistance,	51	70.992 N.m
Flammability Tests,		Self Extinguishing

Ultraviolet Protection to be Achieved by 0.355-mm Exterior Gelcoat

2.10.3 Visual Standards

Visual standards of the finished laminate shall be light gray.

2.10.4 Content Requirements

Enclosure shall be constructed in accordance with the following:

- a. Exterior gelcoat shall be applied to produce a cured film of 0.355 mm plus or minus 0.127 mm in thickness. Distribution of glass reinforcement shall be uniform except in areas of stress concentration where locating reinforcement to thicknesses shown is required.
- b. Mold parts in one piece, including base and door frames. No sectional parts shall be bolted, cemented, or riveted. Except where matte finish is specified, female molds shall be employed to produce high sheen smooth and uniform exterior surfaces.
- c. Doors shall be of identical material and construction as enclosures. Door locking provisions shall result in snug fit of door to frame, with means provided on each door for either a padlock or pintle bolt lock or a combination pintle bolt padlock.
- d. Ventilators shall be of size, number, and location to allow proper transfer of air through the enclosure. Perforated screens of

stainless steel shall be backed with suitable internal baffles to prevent entrance of foreign objects.

## 2.11 NONGALVANIZED ENCLOSURES

Provide enclosure finishes in accordance with the following procedures: Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations.

### 2.11.1 Cleaning

Clean surfaces in accordance with manufacturer's recommendations.

### 2.11.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 0.127 mm. Apply in two coats to a total dry film thickness of 0.127 to 0.2 mm.

### 2.11.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50 percent solids by volume. Apply to a minimum dry film thickness of 0.05 to 0.076 mm. Color shall be the manufacturer's standard.

## 2.12 MISCELLANEOUS ITEMS

### 2.12.1 Cable Tags

Stainless steel, 40 mm in diameter 1.5 mm thick, and circular in shape.

### 2.12.2 Buried Warning and Identification Tape

Provide color, type and depth of tape as specified in paragraph "BURIED WARNING AND IDENTIFICATION TAPE" in Section [02315, "Excavation and Fill"] [02302, "Excavation, Backfilling, and Compacting for Utilities"].

### 2.12.3 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. Braid shall be made from flat tin-plated copper.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions and recommendations and as shown. Provide all necessary interconnections, services, and adjustments required for a complete and operable telephone system. Installation shall be done in

accordance with the safety requirements of CEI 64-8.

### 3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When 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 every event, immediately notify the Contracting Officer of damage.

### 3.1.2 Direct Burial System

\*\*\*\*\*  
**NOTE: Indicate minimum radius allowed.**  
\*\*\*\*\*

Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 600 mm below finished grade. Trenches shall be not less than 155 mm wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than [915] [\_\_\_\_\_] mm. Where two or more cables are laid parallel in the same trench, space laterally at least 75 mm apart. When rock is encountered, remove it to a depth of at least 75 mm below the cable and fill the space with sand or clean earth free from particles larger than 6 mm. Do not unreel and pull cables into the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraphs entitled "BURIED WARNING AND IDENTIFICATION TAPE" in Section [ 02315, "Excavation and Fill" ] [02302, Excavation, Backfilling, and Compacting for Utilities"].

#### 3.1.2.1 Cable Placement

- a. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than [75] [\_\_\_\_\_] mm of well tamped earth. Do not install circuits for communications under or above traffic signal loops.
- b. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.
- c. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.
- d. Leave a horizontal slack of approximately 915 mm in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary

connections.

3.1.2.2 Identification Slabs [Markers]

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 500 mm square by 150 mm thick and stake-mounted warnings.

3.1.3 Underground Duct

Underground duct shall be constructed as specified in Section 16303, "Underground Electrical Work." Ducts under roads, paved areas, and railroad tracks shall be concrete encased.

3.1.3.1 Connections to Existing [Manholes] [Handholes]

For duct line connections to existing structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and [extend it into] [bend it out to tie into the reinforcing of] the duct line envelope.

3.1.3.2 Connections to Concrete Pads

For duct line connections to concrete pads, break an opening in the pad out to the dimensions required and preserve the steel in the pad. Cut the steel and extend it out to tie into the reinforcing of the duct line envelope. Chip out the opening in the pad to form a key for the duct line envelope.

3.1.3.3 Connections to Existing Ducts

Where connections to existing duct lines are indicated, excavate the lines to the maximum depth required. Cut off lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide reinforced concrete collar, poured monolithically with the new duct line to take the shear at the joint of the duct lines.

3.1.4 Reconditioning of Surfaces

3.1.4.1 Unpaved Surface Treatment

Restore unpaved surfaces disturbed during the installation of duct or direct burial cable to their original elevation and condition. Carefully preserve existing sod and topsoil and replace after the backfilling is completed. Replace damaged sod with sod of quality equal to that removed. Where the surface is disturbed in a newly seeded area, reseed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.4.2 Paving Repairs

\*\*\*\*\*

**NOTE: Choose one of the following options.**

\*\*\*\*\*

[a. Where trenches, pits, or other excavations are made in existing roadways and in other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement to the same thickness and to the same kind as previously existed. Surface treatment or pavement shall also match and tie into the adjacent and surrounding existing surfaces.]

[b. Make paving repairs as specified in Section [\_\_\_\_\_, "\_\_\_\_\_"].]

### 3.1.5 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer.

#### 3.1.5.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

#### 3.1.5.2 Pulling Eyes

Equip cables 30 mm in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 30 mm with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 19 mm links between pulling-in eyes or grips and pulling strand.

#### 3.1.5.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and

support cables on brackets and cable insulators at a maximum of 1220 mm. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

### 3.1.6 Cable Splicing

#### 3.1.6.1 Copper Conductor Splices

Perform splicing in accordance with manufacturer's instructions and recommendations except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

#### 3.1.6.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss [not greater than 0.2 dB for fusion splices] [not greater than 0.4 dB for mechanical splices].

#### 3.1.7 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of CEI 64-8.

#### 3.1.8 Grounding

\*\*\*\*\*  
**NOTE: Designer should verify the existence of grounding facilities. It is essential that all grounding facilities, new and existing, conform with CEI 64-8.**  
\*\*\*\*\*

Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals, in accordance to CEI 64-8.

##### 3.1.8.1 Master Ground Bar (MGB)

Provide copper MGB which shall be the hub of the basic grounding system providing a common point of connection for ground from outside cable, MDF, and equipment. Establish a MGB to ground resistance, in accordance to CEI 64-8.

##### 3.1.8.2 Cable Entrance Ground Bar (CEGB)

Provide copper bar for bonding all incoming outside plant cable shields. Connect CEGB to MGB by the most direct route utilizing copper conductor.

##### 3.1.8.3 Main Distribution Frame Ground Bar (MDFGB)

Provide copper ground bar at the bottom of MDF for connection point for cable stub shields to connector blocks and MDF protector assemblies.

#### 3.1.8.4 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the vault.

#### 3.1.8.5 Main Distribution Frame Grounding

- a. Protection assemblies: Mount MDF protector assemblies directly on the vertical frame ironwork. Connect assemblies mounted on each vertical frame with 16 sq. mm copper conductor to provide a low resistance path to MDFGB.
- b. MGB connection: Connect MDFGB to MGB with copper conductor with a total resistance in accordance to CEI 64-8.

### 3.2 FIELD QUALITY CONTROL

Provide the Contracting Officer [10] [\_\_\_\_\_] working days notice prior to [each] [\_\_\_\_\_] test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

#### 3.2.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

##### 3.2.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

##### 3.2.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

##### 3.2.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least [5] [\_\_\_\_\_] working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.2.2 Acceptance Tests

\*\*\*\*\*  
**NOTE: Delete tests that are not required.**  
\*\*\*\*\*

3.2.2.1 Copper Conductor Cable

All or part of the following tests may be required by the Contracting Officer: Shield continuity, conductor continuity, conductor insulation resistance, DC-loop resistance, resistance unbalance, insertion loss, frequency response, line noise measurement, subscriber loop measurements, structural return loss (one or two man), cable carrier insertion loss, and cable carrier frequency response.

3.2.2.2 Fiber Optic Cable

Test optical fiber in accordance with Section 16713, "Fiber Optic (FO) Outside Plant (OSP) Media."

3.2.3 Soil Density Tests

Determine soil-density relationships as specified for soil tests in Section [\_\_\_\_\_, "\_\_\_\_\_."]

-- End of Section --